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THE JOHNS HOPKINS UNIVERSITY

Editor—HENRY E. SIGERIST

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Below: J. A. Scott, H. Toulmin

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VOLUME III MAY, 1935 NUMBER 5

PURITANISM AND THE NEW PHILOSOPHY IN 17TH CENTURY ENGLAND *

DOROTHY STIMSON

Goucher College, Baltimore, Md.

In 1600 England showed little indication that modern experimental science was already under way. By 1687 Harvey, Boyle, Halley, Christopher Wren, Hooke and a great group of less well-known workers had already advanced far along that path and Newton's *Principia* was on the printing presses, thanks to the urgency of his less able but deeply appreciative friends. As far as science is concerned, this was indeed the century of genius.[1] But the psychologists tell us that genius is always present hidden among the multitudes in every age, and the sociologists state that the advances made in any period depend in large measure upon the cultural environment in which genius finds itself. A favorable soil produces a full harvest. Why was English soil in the seventeenth century so notably receptive and ready for scientific workers?

The purpose of this paper is to propose the theory that Puritanism was an important factor, hitherto little regarded, in making conditions in England favorable to the new philosophy heralded by Bacon and in promoting the type of thinking that helped to arouse interest

* Read before the History of Science Society, in joint session with the American Historical Association, Washington, D. C., December 28, 1934.

[1] Whitehead, Alfred N., *Science and the Modern World* (New York, Macmillan Co., 1926), Chapter III: "The Century of Genius."

in science and to create a ready reception for the work of the geniuses produced in that century.

The historical picture is familiar to everyone. The age of Elizabeth had brought peace and the expansion of trade and commerce with the consequent development of a wealthy leisure class some of whom were interested in the promotion of knowledge and education. Sir Walter Mildmay had established his Puritan foundation, Emmanuel College, at Cambridge in 1585, and Sir Thomas Gresham's gift of Gresham College for the citizens of London was being started in 1597 with his house as its center. Sir Henry Savile's professorships at Oxford in geometry and astronomy were soon to follow in 1619. The voyages of the Elizabethan seamen were beginning to give place to the migrations of the settlers and the stimulus of novel sights and products and potentialities in the new world was stirring men's minds and feeding their imaginations even as Bruno's philosophy of a plurality of worlds led others on to dream of romantic voyages to the moon. It is small wonder that Bacon devised the House of Salomon to care for all this wealth of new knowledge and to make it usable for mankind.

Nor was England out of touch with the ferments stirring the continent. Robert Recorde had discoursed upon the Copernican theory even before Elizabeth came to the throne,[2] and Thomas Digges and his followers were giving publicity to the Copernican system and to the idea of an infinite universe years before Gilbert gave to both his conspicuous support.[3] Wilkins writing in 1638 was illustrating his little book with Galileo's pictures of the moon and was bolstering up his defence of the Copernican theory against the denunciation of the Church with many a reference to Kepler, Descartes, Mersenne and other Europeans absorbed in the problems of the new science.[4] But England had one great advantage over the continent during the first half of this century: the wars she fought were on

[2] Recorde, Robert, *The Castle of Knowledge*, 3rd edition (London, 1596), first published 1551.

[3] Johnson, Francis R., and Larkey, Sanford V., *Thomas Digges, the Copernican System, and the Idea of the Infinity of the Universe in 1576.* Huntington Library Bulletin, No. 5, April 1934, pp. 69-117.

[4] Wilkins, John, *The Discovery of a World in the Moone* (London, 1638).

others' soil; she herself had peace for forty years before her Civil War shook her foundations. Furthermore, the power of the Inquisition did not touch her thinkers nor delay their publications. Individual security and independence of thought were, perhaps, more possible in England and in the Low Countries in those times than anywhere else, yet even the Low Countries were feeling the pressure of the Thirty Years' War.

More fundamental in its influence upon science than the peace and economic well-being that characterized the life of many of England's middle class and lesser gentry was the intellectual and religious temper of the age. The Protestant Revolt in its challenge to the authority of the Pope had aroused a spirit of challenge in other fields besides church affairs; and in appealing to the Scriptures with the right of private judgment thereon, the Revolt had developed a powerful force in other fields besides theology. Politics was soon to feel the effects and intellectual life the encouragement that must come from the insistence of the Protestants upon an educated clergy. Where Europe under these influences was drawn into religious warfare that ultimately dragged on into destructive dynastic and political upheavals, England held conferences and signed petitions but shed very little blood.

That particular aspect of the Protestant movement in England known as Puritanism seems either to have been in large measure disregarded or perhaps misinterpreted by the writers on the history of English thought in this period. One finds here and there a suggestion that the "Puritan concentration of attention upon the Bible had a remarkable educative effect on many minds," and that "the insistence on literal truthfulness has probably not been without its effect in developing the scientific temper." To quote further: "As a reforming party they [the Puritans] sat loose to the mediaeval and classical tradition to which the universities were still wedded. They were readier for changes both in method and curriculum. . . . The Puritan assumes that religion must capture the head as well as stir the feelings. And so far the Puritan appeal to reason made for a higher intellectual life and activity. The independence of character

which Puritanism fostered also helped to produce pioneers in intellectual reform."[5]

In a discussion of Puritanism in its relation to the new philosophy, an agreement must first be reached on the meaning of the term Puritanism. Historically the term arises in Elizabeth's reign after the Act of Uniformity in 1559 when Thomas Cartwright, appointed Lady Margaret professor of divinity at Cambridge in 1569, gave such impetus to the Puritan movement by his lectures that he is credited with being its first great leader. In its earlier phases it lasts until the outbreak of the Civil War split its members into sectarian groups compelled to choose between the established church or their own deep convictions. Those divines who stayed by the established church then, hoping that the way might yet open for the recognition of their convictions within its fold, were forced in 1662 to resign their pulpits or accept the Book of Common Prayer. At this time the terminology changes: nonconformity begins and Puritanism as a movement ends, though as a moral and intellectual temper it is with us to this day.[6]

The vast majority of these early Puritans, however, had no thought of separation from the Church of England before 1640;[7] they yearned to see it freed from all trace of popery and only gradually came to seek the abolition of the episcopacy when its modification seemed impossible. It is to this earlier Puritanism that I refer as

[5] Wood, Herbert G., "Puritanism" in Hasting's *Encyclopedia of Religion and Ethics*. See also Lecky, Wm. H., *History of the Rise and Influence of the Spirit of Rationalism in Europe*, revised edition (New York, 1919), vol. II, pp. 87-91; Tulloch, John, *Rational Theology and Christian Philosophy in England in the Seventeenth Century*, 2nd edition (London, 1874), vol. I, pp. 63-75; Dowden, Edward, *Puritan and Anglican* (New York, 1901), pp. 4, 15-16, 32.

[6] Neal, Daniel, *History of the Puritans or Protestant Non-conformists from the Reformation in 1517 to the Revolution in 1688*, new edition in 5 vols. revised, corrected and enlarged (London, 1822), vol. I, pp. vii, ix; vol. II, pp. 113, 116 note; vol. IV, p. 345; Wakeman, Henry O., *Introduction to the History of the Church of England from the Earliest Times to the Present Day*, 7th edition (London, 1912), pp. 333-375, 388; Masson, David, *Life of Milton*, 7 vols. new and revised edition, (London, 1873-94); vol. II, pp. 196-201, 532-534; Firth, C. H., "Introduction," *Letters and Speeches of Oliver Cromwell* with elucidation by Thomas Carlyle, edited by S. C. Lomas, 3 vols. (London, 1904), vol. I, p. xlvi; Grierson, H. J. C., *Cross Currents in English Literature of the 17th Century* (London, 1929), p. 40.

[7] Masson, *op. cit.*, vol. II, p. 590; *Reliquiae Baxterianae* (London, 1696), pp. 32-34.

developing an atmosphere favorable to scientific growth through its emphasis upon the right of private judgment, its critical spirit, its insistence upon knowledge and reason, its independence and uprightness of character and its demand that men spend their time profitably.[8]

It is difficult to estimate how numerous these Puritans were. More than 800 divines were willing to sign the Millenary Petition presented in 1603 to James I soon after his accession to the English throne to ask for the reforms advocated by Puritans, and it is stated that in 1643 only three of the one hundred and twenty clergy in and around London were not Puritan.[9] Yet Baxter, the last great leader of the movement, writing in 1664 was able to say of this earlier period when he was twenty-five years old and an active Puritan divine, that he had "never thought what Presbytery or Independency was, nor ever spake with a man who seemed to know it."[10] In other words anti-prelacy was the prevailing mood rather than separation.[11] If the people follow their religious leaders, then it is not surprising that London was notably a Puritan center,[12] and that the Puritan temper reached far out from the pulpits of these divines, to be at leaast a factor in discussions wherever thoughtful minds were gathered.

At first, to be sure, Puritan was a word of reproach. Owen Feltham writing in the sixteen-twenties, remarked: "I find many that are called Puritans; yet few or none that will own the name. Whereof the reason sure is this, that 'tis for the most part held a name of infamy, and is so new, that it hath scarcely yet obtained a definition. . . . It imports a kind of excellency above another; which man (being conscious of his own frail bending), is ashamed to assume to himself. . . . One will have him that lives religiously, and will not revel it in a shoreless excess. Another, him that separates from our Divine Assemblies. Another, him that in some tenents only is peculiar. Another, him that will not swear. Absolutely to

[8] Sprat, Thomas, *History of the Royal Society*, 2nd edition corrected (London, 1702), pp. 152, 372.
[9] Masson, *op. cit.*, vol. II, p. 534.
[10] *Ibid.*, p. 590; see also *Reliquiae Baxterianae*, pp. 13, 16, 26.
[11] *Ibid.*, p. 26.
[12] Masson, *op. cit.*, vol. II, p. 200.

define him, is a word, I think, of Difficulty; some I know that rejoyce in the name, but sure they be such, as least understand it. As he is more generally in these times taken, I suppose we may call him a Church Rebel, or one that would exclude order, that his brain might rule. . . . For my own part, I think the World hath not better men than some, that suffer under that name: nor, withal, more scelestick villanies," [13] By 1640 the term Puritan was also the recognized name of that party in the state which contended for the constitutional rights and liberties of the people as against the encroachments of the crown. Certainly during the earlier years of the Civil War period Puritan and parliament man were largely synonymous.[14]

Recently a critic has contended that Puritanism in this seventeenth century was the cause of the death of English vocal music and of the English drama.[15] If it is true that the Puritan emphasis upon a high standard of moral living kept sober men away from the Restoration theater, that situation would the more encourage the growth of the new science by attracting to it for recreation and refreshment in worthwhile channels these excellently trained intellects that were weary of the contentions arising from "Discourses of Divinity, State-affairs and of News." [16] The study of God's will as revealed in His works in the natural world would harmonize with the most rigid Puritan thinking, the possible usefulness of the resulting discoveries would justify this use of the time spent, and the zest reflected in the records of the Royal Society make clear to any reader the enjoyment and delight of those participating in these activities. What more suitable recreation could be found for earnest upright men? The more urbane among the thinkers of the day, those with education and experience of travel and affairs, the nobility whose religious views might make court entertainments somewhat distasteful, may well have rejoiced in this opportunity for harmonious, stimulating work with congenial spirits in the Royal Society. A Baxter was too

[13] Feltham, Owen, *Resolves: Divine, Moral and Political*, 9th impression (London, 1670), "Of Puritans," pp. 6-7; see also *Reliquiae Baxterianae*, pp. 2-3, 32.

[14] Neal, *op. cit.*, vol. II, p. 113; Masson, *op. cit.*, vol. II, p. 196; Wakeman, *op. cit.*, p. 375; Brown, John, *English Puritans* (Cambridge, 1912), p. 2.

[15] Grierson, H. J. C., *op. cit.*, pp. 13-79.

[16] Wallis, John, *A Defence of the Royal Society* (London, 1678), p. 7.

deep in his activities for such an interest, perhaps, and many of the citizens of London might lack the polish and the cultivation that would fit them for the society they would find within the halls of Gresham College; but those men who were tinged with the latitudinarianism of Eton [17] and of Cambridge, on whom care rode somewhat lightly at times, these might well find in the pursuit of science the interest and refreshment and the companionship denied to them in other ways. Critics like Grierson who in using the term Puritanism to describe the extremists of the group, the enthusiasts and even fanatics who had no thought or time for ought else but their main preoccupation of religion,[18] disregard the moderates who characterize every party and who perhaps are more truly representative of a party than its extremists. My claim is that these moderate Puritans in their intellectual temper and in their definite personal participation helped to produce the scientific ferment that made ready the soil in which genius flourished.

The test of a theory is in the evidence. And at this point I wish to make plain that this study is in the nature of a report on progress and not a final statement.

The end of historical Puritanism in 1662 is exactly contemporaneous with the rise of the Royal Society, proposed in 1660, first chartered in 1662 and finally organized under its second charter in 1663. This Society became at once the center for most of the scientific work of the time in England, either through the work of its members or by its correspondence with and encouragement of workers both at home and abroad. What evidence is there that Puritanism influenced its origins? The nucleus of the Royal Society was of course the group of young men who were holding weekly meetings in London in 1645 to discuss the new scientific discoveries and other similar philosophical matters with the express proviso that the discussion of "Divinity, State-Affairs and News" was barred.[19] Ten of these men are known: Wilkins, Goddard, Glisson, Scarbrough, Merrit, Haak,

[17] Nicolson, Marjorie, *Conway Letters* (London, 1930), p. 40.

[18] Grierson, *op. cit.*, preface, pp. 186-192.

[19] Wallis, *op. cit.*, pp. 7-8; Sprat, *op. cit.*, pp. 55-56; Stimson, Dorothy, "Dr. Wilkins and the Royal Society," *Journal of Modern History*, vol. III, No. 4, pp. 539-563 (December, 1931).

Wallis, Foster, Ent and Boyle.[20] Wilkins, grandson of an eminent Puritan divine in whose house he began his education, after leaving Magdalen Hall, Oxford, and serving as chaplain to two leading Puritan nobles, was then in London as the chaplain of the Prince Elector Palatine, the candidate of the parliamentary party and next heir to the throne should the Stuart line be dispossessed. His fellow student at Magdalen Hall, Dr. Goddard, was soon to be made warden of Merton College by the parliamentary commission and then Gresham professor of physics. Christopher Merrit and the Protestant German, Theodore Haak, had both attended Gloucester Hall at Oxford. Later Haak was translating the Dutch annotations to the Bible for the Westminster divines. It is perhaps worth noting that during this period before the Civil War the heads of Gloucester and Magdalen Halls, Oxford, were noted Puritan leaders and that Wilkinson, the principal of Magdalen, became an ardent parliament man; also in Anthony Wood's phrase, Magdalen Hall and New Inn Hall at Oxford were "nests of precisians and Puritans."[21] Cambridge of course had long been a center of Puritan influence.[22]

Boyle's education had come from Eton, spoken of as the unofficial dwelling-place of what was later known as latitudinarianism,[23] and from European travel with tutors, an education that made him strongly Puritan. The others of this group were all Cambridge men; Glisson and Scarbrough from Caius where the medical tradition set by Harvey was very strong, Foster and Wallis from Emmanuel, the Puritan stronghold, and Ent from Sidney Sussex where Cromwell had gone for his brief stay. Foster was in London as a Gresham professor and Wallis, after serving as a secretary for the Westminster Assembly was to receive in 1649 a Savilian professorship from the parliamentary commission.

[20] Biographical data for these and the other original members of the Royal Society are from the *Dictionary of National Biography, Biographia Britannica* (edited by Kippis, London, 1780); Ward, John, *Lives of the Professors of Gresham College* (London, 1740); Weld, Charles R., *History of the Royal Society with Memoirs of the Presidents*, 2 vols. (London, 1848); Munk, Wm., *The Roll of the Royal College of Physicians of London*, 2nd edition, revised and enlarged (London, 1878), 3 vols, vol. I, 1518-1700.

[21] Hamilton, Sidney G., *Hertford College* (London, 1903), pp. 107-9.

[22] Masson, *op. cit.*, vol. II, p. 563.

[23] Nicolson, *op. cit.*, p. 40.

Of these ten men known to be members in 1645 of the "invisible college" (to use Boyle's name for it), only Scarbrough at that time was definitely royalist. About two of the others the evidence is not conclusive; though Merrit had a Puritan training and Glisson came to London to live in 1648 when Colchester fell into the hands of the parliamentary forces. The others were all Puritan in training and parliamentary in their affiliation. It cannot be pure coincidence that six of these men should have come from three strong Puritan colleges, two others from a college where the medical influence is strong even to this day and another from Cromwell's college.

When three of the "invisible college" received appointments in Oxford from the hands of the parliamentary commissioners about 1649, the weekly discussions of scientific matters were continued in the new surroundings with many additions to the group. Wilkins as the broadminded warden of Wadham College was respected by Puritan and Cavalier alike and both sides trusted their sons to his charge;[24] so Christopher Wren, Sprat and others like them joined with Boyle, William Petty, Seth Ward and Lawrence Rooke in making this Commonwealth period the most brilliant in the long history of Wadham College.[25] With the shifts caused by the Restoration in 1660 most of these men returned to London where they revitalized the London scientific meetings, welcoming to the group Catholic and Calvinist, tradesman and nobleman,[26] all at one in the strong common interest, experimental science.

By the time the charter of 1663 was granted to this Royal Society, the group was greatly increased. The original list of members recognized at that time numbers 119, twenty-one on the council, the remainder the first fellows. The authorities of the Society today state that of many of these original fellows little or nothing is known.[27] They were mostly "gentlemen, free and unconfin'd," that is, men who were not connected with any of the professions but who "by the freedom of their education, the plenty of their estates and the usual generosity of noble blood, may be well suppos'd to be most

[24] Pope, Walter, *Life of Seth, Lord Bishop of Salisbury* (London, 1697), pp. 27-28.
[25] Wells, J., *Oxford and its Colleges*, 12th edition, revised (London, 1893), p. 262.
[26] Sprat, *op. cit.*, pp. 63, 76.
[27] *Record of the Royal Society*, 3rd edition, revised (London, 1912), p. 21.

averse from sordid considerations."[28] With the facilities at my disposal I can find no information whatever about thirty-two of these 119. Of nineteen more I cannot tell where their political sympathies lay before 1660 nor what their training was, though several of these men were in 1645 but boys of eight and ten, too young for the important decisions of those days. Forty-two of the remainder are Puritan in their training or parliamentary in their affiliation or both, even though they later accepted the Book of Common Prayer along with the Restoration and were conforming to the Church of England. Only twenty-six were definitely royalist before 1660. If the thirty-two unknown names are subtracted from the total of 119, then almost half, or forty-two, of the remaining eighty-seven had had Puritan experience in greater or less degree.[29] Surely this is evidence showing at least a strong Puritan tinge in the Society which led the scientific work of that age.

Perhaps it is still more significant that while in his *History of the Royal Society*, first published in 1667, Sprat listed a membership of about two hundred that included the two archbishops and five bishops,[30] the earlier list of 1663 comprising the original fellows, the men genuinely interested before the king signed the Charter book and before the Society became the fashion, listed[31] but one bishop and that one Seth Ward of the "invisible college" days, now Bishop of Exeter, whose political turning from side to side had aroused considerable question of his sincerity. Later he was to be a leader among the high church party that defeated his old friend Bishop Wilkins' endeavor to win toleration within the Anglican Church for the nonconforming divines, a policy that brought down on his own head the criticism that his zeal was to demonstrate his sincerity and offset his having taken the covenant in the days of Cromwell. The Archbishops of Canterbury and York, the bishops of Winchester, London, Rochester, and Ward's successor at Exeter, all of whom Sprat listed

[28] Sprat, *op. cit.*, pp. 67, 68.

[29] See note 20. Further research is needed before a final statement about the political or religious affiliation of each of these 119 fellows can be given.

[30] Pp. 431-433.

[31] *Record of the Royal Society*, list of fellows from the beginning to the present, with the dates of their election to membership.

among the fellows in 1667 together with Ward then bishop of Salisbury, were all except Ward ardent royalists who had suffered more or less severely for their adherence to the king during the Commonwealth. They were older men rewarded for their loyalty to Charles II by appointment to the highest church offices available, and as his appointees and adherents they followed him in his interests where they could. When the original council named the first fellows in 1663, none of these men except Ward was included in the group. They had all been elected by the Society to membership in 1665 within a few weeks after the day the king, his brother the Duke of York, and the Duke of Albemarle had signed the Charter book, thus making membership in the Society a matter of court fashion and not necessarily of scientific activity.[82] Interestingly enough not one of the biographers of these church dignitaries in the *Dictionary of National Biography* refers to their membership in the Society, so much was it a matter of form for them rather than a mark of genuine interest; and the minutes of the Society in those early years make no reference to their having ever joined in the discussions even if they ever attended a meeting, nor were they named on the committees.[83] But to Sprat their names were evidence to the Society's critics that the Society was under the aegis of the Church.[84] His emphasis on their membership tends to obscure the fact that they were not original fellows, but their presence in his list does not contravene my theory that the moderate group, especially those of Puritan training and background, were among the ones most eager for the new science.

Thus far I have drawn my evidence from the membership of the Royal Society when it was first organized in 1663. Had I taken Sprat's longer list of 1667, other prominent men trained under Puritan influences like Ralph Bathurst, and Gilbert Burnet could have been added; but the factor of court and royal favor is too prominent in 1667 to make the evidence as clearly apparent as in 1663 before the king became a patron. Outside the Society as well, there were Puritans concerned with science. Thomas

[82] *Ibid.*
[83] Birch, Thomas, *History of the Royal Society*, 4 vols. (London, 1756-57), vol. I.
[84] Sprat, *op. cit.*, pp. 132-3, 373-378.

Sydenham, one of the greatest physicians of any age, left Magdalen Hall for military service during the Wars on the parliamentary side,—an active Puritan all his days. Before him Theodore de Mayerne, court physician to James I and Charles I, had been born of Protestant parents in Geneva and was buried in England in 1655 by a Presbyterian divine. Among the correspondents and later members of the Society are Puritans in New England and Protestants from the continent, all trained in calvinistic thinking.

Nor is my theory limited to the moderate group in England alone. As early as in 1659 the new astronomy was recognized in the *New England Almanack* prepared by a young Harvard graduate and fellow, and that *Almanack* was treated in a tolerantly conservative fashion by the leading Puritan divines there in a way quite foreign to the usual opinion of their bigotry and intolerance. Dr. Morison then concludes: "The Puritan clergy, instead of opposing the acceptance of the Copernican theory, were the chief patrons and promoters of the new astronomy, and of other scientific discoveries, in New England." [35] If my theory is correct, this is additional evidence in its favor, for the great majority of these divines were trained at the University of Cambridge and in establishing Harvard College had drawn heavily upon the Cambridge tradition. Masson in listing twenty leading Puritan divines in New England in 1640, found that seventeen of them came from Cambridge and only three from Oxford, and concluded that this represented the probable proportion among the seventy or eighty divines then in New England,—a natural proportion, he remarked, because the University of Cambridge was the alma mater of the Puritans.[36] Furthermore it is well known that Governor John Winthrop of Connecticut was long associated with the virtuosi in England, a relationship that is clearly indicated by the fact that he was elected to membership as an original fellow in 1663 and that his correspondence with the Society officially and with the various members individually forms not the least interesting part of the Winthrop papers to this day.[37]

[35] Morison, Samuel E., "Astronomy at Colonial Harvard," *The New England Quarterly* (March, 1934), pp. 3-24.

[36] Masson, *op. cit.*, vol. II, p. 563; see also, Brown, *op. cit.*, p. 125.

[37] "Correspondence of the Founders of the Royal Society with Governor

We do not yet know what certain studies on Henri Justel now being made may bring forth in the immediate future, but some hint of the close connection between the activities of that leading Huguenot and the progress of science in the seventeenth century is indicated in a preliminary study of Justel by Dr. Harcourt Brown. Dr. Brown speaks of the close relations between Justel and the leading Protestant scientists of the day, such men as Christian Huygens who welcomed his acquaintance in 1661, and Oldenburg with whom he corresponded from 1663 until Oldenburg's death in 1677. Dr. Brown emphasizes the strong Protestant affiliations Oldenburg had through his beliefs, through his marriage with John Durie's daughter, and through all his relations with Robert Boyle. In fact Dr. Brown claims that Boyle's letters from Oldenburg on foreign affairs were largely derived from Justel's to Oldenburg and that Justel was the intermediary between the European scientists themselves and the English group. When Justel finally came to London to live, he was elected a fellow of the Society in 1681 without the formality of nomination at a previous meeting. Dr. Brown's studies in Justel's correspondence with the learned world of Holland, France, Italy, and elsewhere [38] may possibly give further evidence to show the help given science in England as well as on the continent through the trained intelligence of a Protestant thinker.

The limits of this paper do not permit me to pursue further the evidence accumulating in support of my position that moderate Puritanism, the low or broad church position, was helpful rather than harmful to the furtherance of the new philosophy of the seventeenth century, particularly in England where conditions gave greater opportunity for its development than in war-torn Europe. The science of the day certainly afforded an admirable common interest and meeting-ground for men of the most divergent political and religious beliefs, providing them with stimulating themes for discussion and study both in groups and alone, themes that gave recreation and and refreshment while also proving a useful and therefore a profitable

Winthrop of Connecticut between 1661-1672," *Proceedings of Massachusetts Historical Society for 1878* (Boston, 1879).

[38] Brown, Harcourt, "Un cosmopolite du grand siècle: Henri Justel" in *Bulletin de la Société de l'Histoire du Protestantisme Français*, Avril-Juin, 1933, pp. 1-15.

Sydenham, one of the greatest physicians of any age, left Magdalen Hall for military service during the Wars on the parliamentary side,—an active Puritan all his days. Before him Theodore de Mayerne, court physician to James I and Charles I, had been born of Protestant parents in Geneva and was buried in England in 1655 by a Presbyterian divine. Among the correspondents and later members of the Society are Puritans in New England and Protestants from the continent, all trained in calvinistic thinking.

Nor is my theory limited to the moderate group in England alone. As early as in 1659 the new astronomy was recognized in the *New England Almanack* prepared by a young Harvard graduate and fellow, and that *Almanack* was treated in a tolerantly conservative fashion by the leading Puritan divines there in a way quite foreign to the usual opinion of their bigotry and intolerance. Dr. Morison then concludes: "The Puritan clergy, instead of opposing the acceptance of the Copernican theory, were the chief patrons and promoters of the new astronomy, and of other scientific discoveries, in New England." [85] If my theory is correct, this is additional evidence in its favor, for the great majority of these divines were trained at the University of Cambridge and in establishing Harvard College had drawn heavily upon the Cambridge tradition. Masson in listing twenty leading Puritan divines in New England in 1640, found that seventeen of them came from Cambridge and only three from Oxford, and concluded that this represented the probable proportion among the seventy or eighty divines then in New England,—a natural proportion, he remarked, because the University of Cambridge was the alma mater of the Puritans.[86] Furthermore it is well known that Governor John Winthrop of Connecticut was long associated with the virtuosi in England, a relationship that is clearly indicated by the fact that he was elected to membership as an original fellow in 1663 and that his correspondence with the Society officially and with the various members individually forms not the least interesting part of the Winthrop papers to this day.[87]

[85] Morison, Samuel E., "Astronomy at Colonial Harvard," *The New England Quarterly* (March, 1934), pp. 3-24.

[86] Masson, *op. cit.*, vol. II, p. 563; see also, Brown, *op. cit.*, p. 125.

[87] "Correspondence of the Founders of the Royal Society with Governor

We do not yet know what certain studies on Henri Justel now being made may bring forth in the immediate future, but some hint of the close connection between the activities of that leading Huguenot and the progress of science in the seventeenth century is indicated in a preliminary study of Justel by Dr. Harcourt Brown. Dr. Brown speaks of the close relations between Justel and the leading Protestant scientists of the day, such men as Christian Huygens who welcomed his acquaintance in 1661, and Oldenburg with whom he corresponded from 1663 until Oldenburg's death in 1677. Dr. Brown emphasizes the strong Protestant affiliations Oldenburg had through his beliefs, through his marriage with John Durie's daughter, and through all his relations with Robert Boyle. In fact Dr. Brown claims that Boyle's letters from Oldenburg on foreign affairs were largely derived from Justel's to Oldenburg and that Justel was the intermediary between the European scientists themselves and the English group. When Justel finally came to London to live, he was elected a fellow of the Society in 1681 without the formality of nomination at a previous meeting. Dr. Brown's studies in Justel's correspondence with the learned world of Holland, France, Italy, and elsewhere [88] may possibly give further evidence to show the help given science in England as well as on the continent through the trained intelligence of a Protestant thinker.

The limits of this paper do not permit me to pursue further the evidence accumulating in support of my position that moderate Puritanism, the low or broad church position, was helpful rather than harmful to the furtherance of the new philosophy of the seventeenth century, particularly in England where conditions gave greater opportunity for its development than in war-torn Europe. The science of the day certainly afforded an admirable common interest and meeting-ground for men of the most divergent political and religious beliefs, providing them with stimulating themes for discussion and study both in groups and alone, themes that gave recreation and and refreshment while also proving a useful and therefore a profitable

Winthrop of Connecticut between 1661-1672," *Proceedings of Massachusetts Historical Society for 1878* (Boston, 1879).

[88] Brown, Harcourt, "Un cosmopolite du grand siècle: Henri Justel" in *Bulletin de la Société de l'Histoire du Protestantisme Français*, Avril-Juin, 1933, pp. 1-15.

way in which to employ one's time. If singing and the drama were tainted with corruption, science was eminently respectable and also very exciting. It is small wonder that the keenly intellectual leaders in the Puritan world, men willing to sacrifice much for their religious and political beliefs, men like John Winthrop the younger, Robert Boyle and Christian Huygens, were glad to join in this fascinating pursuit and to feel that their days were not unprofitably spent even with all the press of other cares upon them. That experimental science spread as rapidly as it did in seventeenth century England seems to me to be in part at least because the moderate Puritans encouraged it.

THE CONTEMPLATIVE WORKS OF CLAUDE BERNARD

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A scientist is always severely condemned by his fellow scientists when he essays a flight into philosophy, as so many scientists who have reached a certain age are inclined to do; nor are the philosophers waiting to receive him with open arms. The excursions of Claude Bernard into this alien territory, however, command respect, for he did have a coherent set of ideas, and they appear to have come to him not at the normal age of professorial retirement but fairly early in his career.

In this respect he may be contrasted with his warm personal friend, Pasteur, who, with Bernard, gave France world-leadership in the medical sciences of physiology and bacteriology in the middle of the nineteenth century. Pasteur was a practical scientist whose experiments had most dramatic results — Bernard had theoretical leanings which tempted him to generalize; and it was this difference in temperament which caused Bernard unwittingly to inflict upon Pasteur one of the most bitter experiences of his life. What made it worse was that the incident occurred after Bernard's death so that the two friends could not talk the matter out. Pasteur was convinced from his experiments that fermentation of grapes could occur only if living yeast cells were present. Bernard, holding the general idea that all living phenomena are subject to the laws of physics and chemistry, was on the track of isolating the chemical substance in the yeast cells which caused the change from grape sugar to alcohol. He had said almost nothing about this work to others, but after his death the results of a few inconclusive experiments were found in a closet drawer in his room and d'Arsonval, his faithful assistant, was instrumental in having them precipitately published over Bernard's signature. Pasteur was terribly hurt, for the way the notes were worded was an absolute condemnation of all his views of fermentation. " Bernard is a slave to his preconceived idea that destruction must be the same whether through vital action or in a cadaver after death," shouted Pasteur, and rushed away to his vineyard in the

Jura to swathe his grapes, while still green, in cotton to protect them from yeast cells, in order to demonstrate that the grapes when ripe would not ferment unless the living yeast cells were present — thereby showing that he had entirely missed Bernard's point.

Pasteur was always dramatic and spectacular; he always had something to offer the public and Bernard's fame continually suffers in comparison. Today even the man in the street knows the name of Pasteur and associates him with the discovery of germs, for he has a daily reminder in the milk he drinks if it has been pasteurized. But how many would know that it was Claude Bernard who discovered the glycogenic function of the liver and vaso-motor nerves, and who proposed the doctrine of the '*milieu intérieur*'? Yet these latter are as fundamental for medical science as the germ theory of disease. If one dismisses from one's mind the relative popularity of these two men of genius and considers their influence on medicine as a whole, one must admit that Pasteur remains a practical scientist, while Bernard's more philosophical mind has furnished certain broad and generalized concepts whose possibilities and implications are only now being recognized.

I should, however, be conveying an entirely erroneous impression if it were thought that Bernard indulged in unbridled flights of speculation. No scientist ever had his feet more firmly fixed on solid ground than he. None ever pursued more carefully the *via media* between the mere formulation of a logical scheme and the mere observation of facts. He had an abhorrence for any set system of thought. His position on this point is made clear in the following passage:

"I have warned biological science and experimental medicine against the exaggerations of erudition (Bernard finished 26th out of 29 in his class in medicine) [1] and against the invasion and domination of systems; because sciences submitting to this would lose their fertility and would abandon the independence and freedom of mind esssential to the progress of humanity." [2]

Because Bernard was so eminently respectable as a scientist and because his very name became so mighty a symbol of authority, the

[1] Franklin, A. W., *St. Barth. Hosp. J.*, 1928, 36, 2.
[2] Bernard, C., *Intro. méd. exp.*, p. 396; cf. *Sc. exp.*, p. 96.

contemporary advocates of various systems of thought sought eagerly to have him on their side. Mechanists, materialists and positivists bid unsuccessfully against each other for his patronage.[3] Even the vitalists, against whom he hurled bitter anathemas in his lifetime, dared, after he was dead, to cite passages in his works which they thought justified them in including him as one of themselves. Driesch, for instance, holds that Bernard was a critical vitalist or, at least, not an uncritical mechanist.[4] All this in spite of the fact that Bernard expressly stated that he belonged to no school of philosophical thought. "Truth," he remarked, "if one can find it, belongs to all the systems."[5] It was this aspect of Bernard's teaching that was seized upon by Bergson,[6] who, after praising Bernard for enunciating the paradox, "Philosophy should not be systematic,"[7] proceeds to use statements like "Systems do not exist in nature but only in men's minds"[8] to make Bernard appear as the forerunner of his own philosophical *system*.

No writer's words should be considered apart from their context, but in Bernard's case one must take into account not only the context but also the special circumstances under which the words were written. When his works are referred to, what is meant are the eighteen volumes which Ch. Richet said every physiologist should read and re-read both for pleasure and for profit, but which Sir Michael Foster said were too inaccurate to be placed in the hands of a beginner. Only three of these volumes actually came from the pen of Bernard. It was his custom to use the notes taken by a student in attendance at his lectures and demonstrations at the Collège de France, the Sorbonne, or the Muséum d'histoire naturelle, as the basis for his published work. This student was usually one who

[3] *v.* Correspondence of M. Charles Richet and M. Letourneau, *Revue scientifique*, 1879, XVII, pp. 303, 377. For the Positivists *v.* "Claude Bernard" by Matthias Duval, *Revue de philosophie positive*, mai et juin, 1878, and M. Littré's reply in the same journal.

[4] Driesch, H., *The history and theory of vitalism*, pp. 132-137.

[5] Bernard, C., *Intro. méd. exp.*, p. 391.

[6] Bergson, H., "La philosophie de Claude Bernard," *Les Nouvelles littéraires*, 17 nov. 1928.

[7] Bernard, C., *Intro. méd. exp.*, p. 391; cf. *Sc. exp.*, p. 91.

[8] Bernard, C., *Intro méd. exp.*, p. 387; cf. *Sc. exp.*, p. 84.

was also working in Bernard's laboratory at the time and was therefore familiar with the experimental work in progress.[9] It is only fair to lay emphasis on the fact that, with the exception of one volume and part of another published posthumously, the preface of each book states that the lectures were reviewed and corrected under Bernard's own eyes. We, in America, may feel an interest in the circumstance that the first lectures of Bernard to be published in book form were the notes of a young Philadelphia doctor. The book is in English and was published in the United States.[10]

There are, however, and most fortunately so, it seems to me, three

[9] A. Tripier, who assisted Bernard in this way for eight years (1854-1863), himself gives an account of the process in a footnote to "Notes for an unpublished lecture by Claude Bernard" which appeared posthumously in *Mémoires de la société de biologie* (1884, 36, p. 101). M. Tripier says:

"The data which I used for the publication of Claude Bernard's lectures came from several sources. The most important was, up to 1859, making abstracts of notebooks which contained the records of experiments accumulated during nearly 20 years of incessant laboratory work. These transcriptions of experiments were divided into three classes: some were set aside to be supplemented by future investigations; others were to be used as illustrative material in the teaching then in progress; still others were destined to fill in lacunae and supply omissions in the lectures already given but not yet published.

"In the course of this transcription, there arose theoretical views, ideas of a new form to be given to certain expositions, and also projects for research. Bernard dictated notes of these to me and they were submitted to the same classification as the notes of experiments and sometimes ended in constituting plans for lectures. . . .

"As for the notes taken in the course of lectures, the same method was followed with them as with those dictated in the office: some remained where they were; others were reassigned to previous lectures; still others were put in reserve. This classification was left to me, Bernard reserving to himself the revision of a version that was usually final. . . .

"In the lifetime of Bernard, I should, as I had done many times for the publication of lectures which were to be added only later to the edition of his work, have altered and condensed the wording with a view to making it render as best I could the parent idea of the article. Now that Bernard is dead, I no longer felt this liberty permissible."

Cf. also the case of *Leçons de pathologie expérimentale*. Dr. Benjamin Ball had translated into English Bernard's series of lectures given at the Collège de France in 1859-60 and published them in the *London Medical Times and Gazette*. Bernard had Ball translate the English back into French, "in order," he said, "to render the reproduction as faithful as possible." *v. Path. Exp.*, p. vi.

[10] Atlee, Walter F., M. D., *Notes of M. Bernard's lectures on the blood* (Phila., Lippincott, Grambo and Co., 1854).

exceptions to his general practice, that is, there are three volumes in which he actually wrote out his thoughts in the form in which he wished them to be read. These are "Introduction à l'étude de la médecine expérimentale," which appeared in 1865; "Rapport sur les progrès et la marche de la physiologie générale," 1867; and "La science expérimentale," 1878.[11] These three volumes and certain of the lectures which Bernard gave at the Muséum d'histoire naturelle, entitled, "Leçons sur les phénomènes de la vie communs aux animaux et aux végétaux," I have designated the *contemplative works* of Claude Bernard, since they embody the results of his thinking rather than of his experimentation.

There is really an appalling amount of repetition throughout the whole series of Bernard's works. Not only in what I call the contemplative works but also in his scientific works, the same ideas continually crop up, namely, the necessity for experiment in the biological sciences, the function of hypothesis, the distinction between first causes and immediate causes or conditions, scientific determinism, the distinction between vital force as a legislative and an executive agent, the division of living phenomena into organic destruction and organic creation, the concept of the internal versus the external environment. Certain of these topics, of course, are treated with greater emphasis in one book than in another, and I shall be guided by this emphasis in relating a particular topic to a particular book. In "Introduction à l'étude de la médecine expérimentale," which, for the sake of brevity, I shall refer to as the "Introduction" and which I shall deal with first, Bernard has arranged these ideas in an account of the mental processes involved in scientific experimentation.

Probably we should never have had this volume had Bernard not been attacked by an illness so severe that for several years he could give no lectures nor could he even direct experimental work. The illness was never accurately diagnosed. It was probably an abdominal abscess [12] or possibly appendicitis, for the pain was not continu-

[11] The actual manuscript of "Introduction à l'étude de la médecine expérimentale" was deposited by Professor d'Arsonval, to whom it had been bequeathed by Bernard, in the *musée Claude Bernard* inaugurated at the Collège de France in January, 1935. The manuscript is contained in a bound account book and there is a label pasted on the cover bearing the extremely simple inscription, *Livre.* (*v. l'Illustration*, 19 Janvier, 1935).

[12] *v.* Foster, Sir Michael, *Claude Bernard*, p. 181.

ous but occurred with severity at intervals. In 1862 the periods of pain became so frequent that he withdrew from Paris to the little village where he was born, St. Julien, near Lyons, where the gentle countryside was dotted with vineyards and the very air gave him peace. It was during these enforced sabbatical years that he had the time to collect and shape his thoughts, for as he himself said, he could do nothing but think. As he sat on what he called the "banc de Sisyphe" [13] — a mild professorial pun, since the bench was placed at the end of a row of six yew trees, *six ifs* in French — and looked out over vine-clad hills toward Mont Blanc, he pondered over the plans he had made four years before for a huge work on experimental medicine. This was to be a comprehensive treatise which would gather together into a coordinated whole all of what he termed "the scattered fragments of my studies." [14] Between bouts of pain he tried to probe deep into his mind to see just how it was that he had happened to come upon the discoveries he had made, what were the mental processes which had led him to adopt one experimental method rather than another, and what were the general principles underlying the existence of living creatures.

When the results of this self-examination were written down he decided to use them as the introduction to the treatise. This is the reason for the title "An introduction to the study of experimental medicine." The introduction was published but the rest of the treatise was never written. It must be remembered, therefore, that Bernard did not intend this book to stand alone; it was merely a part of a larger whole, so that the significance which one generally reads into the title, viz., the elements or first principles of the experimental method, was not exactly the idea Bernard intended to convey.

He begins the "Introduction" by establishing the relation between an observational science like astronomy and an experimental science like physiology. An experiment to Bernard is simply an induced or provoked observation. He contrasts the scholastic and experimental approaches to a problem and estimates the part played by the intellectual processes, intuition and reason, in the experimental

[13] Genty, le Dr. Maurice, *Claude Bernard* (Les biographies médicales, No. 10, Octobre, 1932), p. 130.

[14] Bernard, C., *Path. exp.*, p. vi.

method. He says that intuition or feeling begets the experimental idea and reason devises the actual experiment. Once the experiment is started, the experimenter's attitude is one of scientific doubt both as to the soundness of his idea and also as to the value of his means of investigation, but he never entertains a doubt as to the validity of the principle of determinism, a principle which Bernard proceeds to define and elaborate in his next section.

He states that the apparent spontaneity of living beings is no obstacle to experimentation upon them, since the necessary conditions of natural phenomena are absolutely determined in living bodies as well as in inorganic bodies. What he means by the principle of determinism is simply this: under identical conditions the resulting phenomena will be identical, and in opposition to his immediate predecessors he maintained that the principle held for animate as well as inanimate bodies. He introduces here his famous conception of the '*milieu intérieur*,' the internal environment, showing that phenomena peculiar to living beings, particularly the higher animals, e. g., mammals, take place in a perfected internal organic environment. Determinism implies that the limits of our knowledge are the same for the phenomena of living bodies as for those of inorganic bodies. First causes are in both cases inaccessible and immediate causes in both cases absolutely determined. Experimental science should not trouble itself with the question 'why'; it explains 'how,' nothing more.

He admits, however, that there are experimental considerations peculiar to living beings. A living being must be treated as a harmonious whole, and a special technique for experimentation developed. The book concludes with illustrations drawn from his own experiments in which he has applied the principles laid down in the earlier part of the work. These are the bare bones of his argument.

Personally, I find the first part where Bernard is laboring so hard to distinguish between observation and experiment rather dry reading. I grow restive when I am warned that the results of an experiment must be noted with a mind stripped of hypothesis and preconceived ideas, but that I must use my imagination in devising experiments. Nevertheless, in spite of the apparent obviousness of such statements, it is not so easy to devise a perfect experiment as

the uninitiated might think. The definition of experiment recently tossed off by Mr. Whitehead sounds like one formulated by a philosopher or a mathematician who had never attempted to force nature to answer a question in the laboratory. He says that "an experiment is nothing else than a mode of cooking the facts for the sake of exemplifying the law." [15] This *ex cathedra* pronouncement has its germ of truth, but Bernard's account of how the mind of a scientist really works deals more adequately with the full situation:

"The true scientist is one whose work includes both experimental theory and experimental practice. (1) he notes a fact; (2) à propos of this fact, an idea is born in his mind; (3) in the light of this idea, he reasons, devises an experiment, imagines and brings to pass its material conditions; (4) from this experiment new phenomena result which must be observed, and so on and so forth. The mind of a scientist is always placed, as it were, between two observations: one which serves as a starting point for reasoning, and the other which serves as conclusion." [16]

It is Bernard's contribution to have described perfectly, and out of his own experience, the collaboration of mind and nature, of fact and idea, which takes place in the experimental method.

Instead of starting from a fixed and indubitable self-evident truth, as Descartes proposed in his famous method, a method which he never succeeded in putting into practice in his biological investigations,[17] Bernard starts with an hypothesis which is not absolute, nor beyond the reach of experiment. Even when he does verify his hypothesis, this is not the end; there is still doubt. He says:

"The theories which embody our scientific ideas as a whole are, of course, indispensable as representations of science. They should also serve as a basis for new ideas. But as these theories and ideas are by no means immutable truth, one must always be ready to abandon them, to alter them or to exchange them as soon as they cease to represent the truth. In a word, we must alter theory to adapt it to nature, but not nature to adapt it to theory." [18]

[15] Whitehead, A. N., *Adventures of ideas*, p. 111.
[16] Bernard, C., *Intro. méd. exp.*, pp. 43-44; Eng. tr. by Greene, H. C., p. 24.
[17] Stock, H., *The method of Descartes in the natural sciences.*
[18] Bernard, C., *Intro. méd. exp.*, p. 70; Eng. tr., p. 39.

In illustration of this point he made the prophetic statement: " The chemist's elements are elements only until there is proof to the contrary." [19] Three-quarters of a century later physicists and chemists are engrossed in " proof to the contrary."

The fundamental principle which makes experimentation on living things possible is determinism, or, as Bernard puts it in another place,[20] an experiment (on a living being) *perfectly* carried out will always give the same results. To one not familiar with the attitude of scientists in Bernard's youth the amount of space he devotes to this subject and the feeling he displays over it seem quite out of proportion to its importance. His concern is comprehensible when one remembers that leaders like Cuvier, Bichat and even Magendie, Bernard's own master, held that in living things there was a vital force which really acted in opposition to, and could and did nullify, the physico-chemical laws obeyed by inanimate matter. Cuvier's description of a female body in the heyday of youth and health, suddenly struck down by the hand of death, had made an ineffaceable picture in the young Bernard's mind:

" Behold," Cuvier had said, " this rounded and voluptuous form, this gracious suppleness of movement, this gentle warmth, these rose-tinted cheeks, these eyes sparkling with love or the fire of genius, this physiognomy lit up by flashes of wit or animated by the fire of passion; all seem to unite to make an enchanting creature. An instant is enough to destroy this magic spell: often, without apparent cause, movement and feeling cease, the body loses its warmth, the muscles sink away and allow the angular protuberances of bone to appear; the eyes become cloudy, the cheeks and lips livid. These changes are only the prelude to others still more horrifying: the flesh turns blue, then green, then black; it absorbs moisture, and while part of it evaporates in corrupt emanations, the rest liquifies into a putrid mass which soon likewise melts away; in a word, after only a few days, there remains only a little earth and salt; all the other elements have dispersed into the air and water to enter into other combinations."

[19] Bernard, C., *Intro. méd. exp.*, p. 87; Eng. tr., p. 49.
[20] Bernard, C., *Path. exp.*, p. 219.

Thus did professors in France endeavor dramatically to impress the young minds of their pupils.

" It is clear," Cuvier had resumed, " that this dissolution is the natural effect on the dead body of air, humidity, heat, in short, of all the exterior agents, and that it is caused by the particular attraction of these diverse agents for the elements which compose the dead body. Nevertheless, during life this body was surrounded by these very agents; their affinities for its molecules were exactly the same, and they would have been equally successful, had the living body not been held together by a force superior to these affinities, a force which only ceased to act at the moment of death." [21]

Bernard struck with all his might at this conception that there was in living things " a vital force in opposition to physico-chemical forces, dominating all the phenomena of life, subjecting them to entirely separate laws, and making the organism an organized whole which the experimenter may not touch without destroying the quality of life itself," [22] — a force rendering experimentation applicable only to inorganic bodies, not to living ones. Vitalism, he said, implies indeterminism, and he was set like a hair trigger ready to go off at the slightest mention of the word. Indeed, about the worst thing he could say of a fellow scientist was that he entertained vitalistic notions. One of the exceedingly few times that Bernard was so provoked that he resorted to sarcasm in a lecture was when a former pupil of his, an Englishman named Pavy, claimed that the transformation of glycogen in the liver into sugar did not occur naturally in life but was a morbid process, taking place when the liver was removed from the body. " This," said Bernard, " is harking back to old vitalistic notions. If this were the case, the diabetics we see in our hospitals would be merely walking corpses, a truly bizarre conception." [23] Yet here again, in spite of his personal feeling, Bernard showed his ability to steer a successful middle course, for he said: " Physiological science must look for its basic principles neither in the hypothesis of the vitalists, nor in the exclusive views of the

[21] Bernard, C., *Sc. exp.*, pp. 165-166.
[22] Bernard, C., *Sc. exp.*, p. 39.
[23] Bernard, C., *Leçons sur le diabète*, pp. 347-349.

physico-mechanists, but only in the organic structure of living things." [24]

Personally, I have never met a respectable vitalist who would not agree with Bernard in all he has to say about scientific determinism. He belonged to a different era from the present one, and the physiologist has no longer to combat the idea of a mysterious and indeterminable vital force. This is not to say, however, that Bernard did not recognize that there was a subtle difference between living and non-living things. For " vital force " he substitutes the idea of " creative organization," but the created organism is a machine which necessarily works by virtue of the physico-chemical properties of its constituent elements and is therefore " obedient to rigorous determinism." I shall have something to say later about the effect on Bernard's thought of this analogy of the machine.

Bernard distinguished sharply between his scientific determinism and the philosophic determinism of which Leibniz was the exponent.[25] He nowhere undertakes to discuss the ultimate, as opposed to the empirical, validity of his determinism. He evidently thought that this principle came under the heading of inaccessible first causes. Philosophic determinism meant to him " the negation of human liberty," whereas scientific determinism, he said, far from being the negation of moral liberty, is " its necessary condition." [26] The example he gives is this: if the mechanism for moving your arm were not absolutely determined and fixed, you would not be free to move your arm in the direction you wished. It is evident that Bernard believed firmly in the doctrine of free will, but nowhere does he attempt to justify his position, unless such a justification is implied in the following passage where he appears to assume that the performance of unpredictable human acts is evidence of the exercise of free will. He says, " The presumed anatomical and physico-chemical integrity of your cerebral organ leads you to predict that its function will be perfectly exercised, and that you will be free to act voluntarily, but you cannot predict the way in which your will is

[24] Bernard, C., *Rapport*, pp. 136-137.
[25] Bernard, C., *Phén.*, I, p. 56.
[26] Bernard, C., *Phén.*, I, p. 61.

going to act, because that is dependent upon the contingency of events of which you are ignorant, or which you cannot foresee." [27] The argument from unpredictability to freedom is, of course, inadmissible.

To me, as a physiologist, the most fascinating part of the "Introduction" is towards the end where Bernard gives concrete examples of how the principles laid down in the earlier parts of the book led him to particular discoveries. One example will suffice:

"One day rabbits from the market were brought into my laboratory. They were put on the table where they urinated, and I happened to observe that their urine was clear and acid. This fact struck me, because rabbits, which are herbivora, generally have turbid and alkaline urine; while, on the other hand, carnivora as we know, have clear and acid urine. This observation of acidity in the rabbits' urine gave me an idea that these animals must be in the nutritional condition of carnivora. I assumed that they had probably not eaten for a long time, and that they had been transformed by fasting into veritable carnivorous animals, living on their own blood. Nothing was easier than to verify this preconceived idea or hypothesis by experiment. I gave the rabbits grass to eat; and a few hours later their urine became turbid and alkaline. I then subjected them to fasting and after twenty-four hours or thirty-six hours at most, their urine again became clear and strongly acid; then after eating grass, their urine became alkaline again, etc. I repeated this very simple experiment a great many times, and always with the same result.

. . . The inductive reasoning which I implicitly went through was the following syllogism: the urine of carnivora is acid, now the rabbits before me have acid urine, therefore they are carnivora, i. e., fasting. This remained to be established by experiment." [28]

We have here the sequence that Bernard outlined: (1) the chance observation, (2) the idea born in his mind, (3) the reasoning which led to the devising of an experiment, (4) the observation of result, (5) the devising of new experiments which incidentally led to the

[27] Bernard, C., *Phén.*, I, p. 62, note.
[28] Bernard, C., *Intro. méd. exp.*, pp. 267-269.

discovery of one of the most important functions of the pancreas, the secretion of the enzyme, lipase, which aids in the digestion of fats.

On the whole, then, I can agree with L. J. Henderson when he says in the foreword to the English translation [29] of the " Introduction ":

" It is, therefore, not the least of the merits of Claude Bernard's 'An introduction to the study of experimental medicine' that we have here an honest and successful analysis of himself at work by one of the most intelligent of modern scientists, a man of genius and a great physiologist."

The effect of this book on his own generation was remarkable, and recognition of its merits gained him election to the French Academy, the right to an arm chair among the forty immortals.[30] Bernard was not an impressive public speaker, and the audience on the occasion of his reception into the Academy was disappointed when the customary eulogy of his predecessor was followed by a summary of the ideas he had already expressed in the " Introduction." During the last days of the Empire those who attended the premieres of the new Academicians expected to be amused. Anyone knowing Bernard would have realized that the last thing in the world he was capable of doing was amusing people. His address was much too solid and heavy for the digestions of his listeners, and the sympathetic reporter for the *Figaro* complained that the audience, " despite its pretensions to being the very upper crust of French intelligence, gaped as at an inferior vaudeville."

One peculiar and rather unexpected result of the publication of the " Introduction " was its effect on French literature. Not only did Zola use it as the subject of an essay entitled " The experimental novel," in which he quoted Bernard extensively, remarking, " Very

[29] Bernard, C., *An introduction to the study of experimental medicine*, translated by H. C. Green, with an introduction by L. J. Henderson.

[30] One is tempted to refer to an indelicate tid-bit in the *Goncourt Journal* relating to Bernard's reception into the Academy (Vol. III, p. 295) : " 30 avril—En ce moment, chose bouffonne, Claude Bernard tarde à être reçu à l'Académie, parce que Patin ne peut pas lui repondre. Le malheureux Patin oublie tous les jours, au bas de l'escalier, la physiologie que le physiologiste lui a apprise dans son cabinet."

often it will suffice if I simply replace the word 'physician' by the word 'novelist'; but it inaugurated a new tradition in fiction, the naturalistic novel.

The second contemplative work, "Rapport sur les progrès et la marche de la physiologie générale en France," came into existence at the request of the Emperor Louis Napoleon's Minister of Public Instruction, M. Duruy. It was he who, when asked what he thought of the physiologist, Claude Bernard, replied, "Claude Bernard is not a physiologist, he is physiology." In 1867 occurred one of the most famous of the International Expositions held in Paris. Queen Victoria, although suspicious of things French, even allowed the Prince of Wales, clad in Tartan kilts, to be the guest of Louis Napoleon and Eugenie. Among other things calculated to impress visiting foreigners with the glories of *la belle France,* the Minister of Public Instruction had reports written by prominent savants on the progress of letters and the sciences in France, and then had them published by the Imperial press at the expense of the state.

Now, Bernard had long been ashamed of the miserable hole of a laboratory he had inherited at the Collège de France from Magendie as Professor of Medicine. He particularly envied the magnificent structure erected at Leipzig for Liebig, and he never failed to enumerate the handsome appointments of this building, including a suite for the professor's habitation. Bernard felt that the first step on the way to this magnificence was a declaration of the independence of physiology as an experimental science from any allegiance which it might have owed in its early stages to zoology and anatomy. The two latter sciences were still chiefly concerned with classification and description, and their professors were more inclined to spend money on elaborate museums than upon experimental laboratories. Physiology had originally been taught in many universities under the auspices of the chair of Anatomy, and it was only with reluctance that anatomists acquiesced in the curtailment of their temporary powers by the establishment of independent chairs of physiology. Bernard, it is true, had his own chair in General Physiology at the Sorbonne, but there was no laboratory in connection with it. In the "Rapport" his thesis is that physiology in France has amply earned the right to independence and adequate support.

He enumerates the physiological discoveries to be credited to the glory of French physiologists. They had never been lacking in genius, but they had lacked the material means for allowing that genius to express itself. Because Bernard wished to drive home the point that special facilities must be furnished to the physiologist on account of the special nature of the subject matter of the science, i. e., living organisms, he was led in this report to state with some emphasis his own conception of the organism. In the same year he sent to the *Revue des Deux Mondes* an essay on " Le problème de la physiologie générale," which deals more briefly with the same subject. This essay was reprinted with a number of others in " La science expérimentale "; and two essays in particular in this collection, " Du progrès dans les sciences physiologiques," first published in 1865, and " Définition de la vie," first published in 1875, reinforce and restate the position taken in the " Rapport."

In all four sources, Bernard presents his ideas in the same order. He states that life is no obstacle to experimental analysis, that living beings are subject to absolute determinism. They are in that sense machines. Nevertheless, the distinction between animate and inanimate bodies cannot be ignored. What is Life? Bernard's first answer is the spectacular one which sees life as the other side of death. " Life is creation! " he says in one place; and again, " Life is death! " [31] This to Bernard is only an apparent paradox; the ideas are really complementary, not antithetical. He divided phenomena which take place in the living being into the processes of creation, organization, and nutrition, on the one hand, and those of disintegration and destruction on the other. Both sets of processes are open to chemical analysis. Nevertheless, turning as he did, from the mere analysis of organic substances which had absorbed his immediate predecessors to the investigation of the working organization of the living being as a whole, Bernard found himself not quite satisfied. He pointed out that living organisms have anatomical apparatus and organic tools peculiar to them.[32] His exact words in the essay on " Le problème de la physiologie générale " are: " In the living being, phenomena are realized by the aid of vital processes and organized

[31] Bernard, C., *Phén.*, I, pp. 40-41.
[32] Bernard, C., *Sc. exp.*, p. 114; cf. *Rapport*, p. 136, notes 212-214.

chemical reagents created by histological evolution, which, therefore, are special to the organism and cannot be imitated by the chemist." [33] It would seem that he had in mind those peculiar chemical substances of which haemoglobin, adrenalin, and thyroxin are familiar examples. Had he not been so possessed by Descartes' idea that the living organism is a physical machine, and had he had more faith in his own conception that the living organism is maintained by a balance of chemical reactions, he would, perhaps, have realized that the synthesis of the first peculiarly organic substance, urea, which was successfully accomplished by Wohler when Bernard was in his 'teens, would be followed by the synthesis of many of these compounds " special to the organism." Indeed, as I remarked at the beginning of this paper, he himself was on the way towards isolating the ferment from yeast cells when he was interrupted by death. Nevertheless, because of the state of science in his day and his historical background of general ideas, he felt it necessary to restate the old duality between organization and mechanism. He credited the special morphology of living beings to " legislative or evolutive forces," which were in turn subject to primary causes, inaccessible to scientific investigation. On the other hand, his " executive forces " were the same for animate and inanimate beings. These were the secondary causes, or conditions, open to scientific experimentation. The character of his distinction between primary and secondary causes is shown in his statement that " In vital and physical phenomena alike a complete knowledge of the *conditions* of their existence, i. e., of their secondary causation, tells us nothing of their ultimate nature." [34] It was particularly when he was faced with the problem of the development of the egg that he felt the need of the recognition of the directive forces of life, and he says that in the last analysis the *quid proprium* of life is the " propriété évolutive." [35] It is phraseology of this kind, especially in the " Phénomènes," which led Driesch to claim Bernard as a critical vitalist.[36] The best commentary on Bernard's position seems to me to be his remark at the end of his essay on " Définition de la vie," written three years before his death:

[33] Bernard, C., *Sc. exp.*, p. 115.
[34] Bernard, C., *Sc. exp.*, p. 58.
[35] Bernard, C., *Sc. exp.*, p. 210.
[36] Bernard, C., *Phén.*, I, pp. 50, 51.

" In saying that life is the directing idea and evolutive force of the living being I express merely the idea of a *unity* in the succession of all the morphological and chemical changes accomplished by the germ from the beginning to the end of life." [87]

The notion of organic unity is the valuable aspect of his thought, which he carried over into the fruitful conception of the *' milieu intérieur.'*

You may wonder whether this " Rapport sur les progrès et la marche de la physiologie générale en France " brought the desired results. It did. The Emperor bestowed upon Bernard the professorship in physiology at the Muséum d'histoire naturelle when Flourens died the following year; and with this new professorship went a new laboratory, specially equipped and provided with adequate funds for its maintenance. The lectures he gave here dealt more exactly with general physiology than those he had formerly given at the Sorbonne under this title, since those at the Muséum were designed to show that the same physiological principles underlie all vital phenomena, hence the title he chose for them: " Phénomènes de la vie communs aux animaux et aux végétaux." In the introductory lectures he went over all his old ideas, virtually adding nothing new to his position. I have, however, reserved a discussion of what I consider to be his most valuable contribution to biological thought to the end, since so many contemporary references to the ' milieu intérieur ' are taken from the " Phénomènes."

The essence of the idea of the ' milieu intérieur ' is that the cells within living bodies, particularly of the higher organisms, are bathed by fluids which constitute an inner environment. Life is possible only if the composition of these fluids varies within extremely narrow limits. The tendency of the living body is to maintain as constant as possible the composition of this internal environment, and if the dynamic equilibrium is slightly upset in one direction, reactions take place which tend to restore the balance. A higher organism is, therefore, virtually independent of its external environment. It is, as it were, " enclosed in a hot house," so that " the perpetual changes of its cosmic environment do not reach it; it is not chained to them; it is free and independent." [88]

[87] Bernard, C., *Sc. exp.*, p. 210.

[88] Bernard, C., *Phén.*, I, p. 113.

Bernard's original conception was that the *blood* constituted the 'milieu intérieur,' and L. J. Henderson [39] has followed out this idea in an attempt to show the adjustments taking place simultaneously in six of the components of blood which are linked to each other in a twenty-sided equilibrium. He has represented the results in his now famous nomogram. Cannon [40] also, although in a less mathematical manner, has discussed the action of the autonomic nervous system from a similar standpoint, and has shown how his many years of experimentation have all been directed to the demonstration of the validity of Bernard's conception of the internal environment.

Finally, still more recently there has appeared Barcroft's "Features in the architecture of physiological function," which takes as its text this quotation from Bernard, "La fixité du milieu intérieur est la condition de la vie libre." [41] Henderson and Cannon had been working towards the establishment of the first part of Bernard's statement, i. e., proof that the internal environment is fixed. Barcroft, on the contrary, was struck by the contrast of the two adjectives 'fixed' and 'free.' How can fixity in the internal environment make for a free life? The answer he finds is most illuminating, particularly for the psychologist. Gross variations in the internal environment all result, not in devastating disturbances in such body functions as heart action, muscular efficiency, kidney function, etc., no! — variations in the internal environment result in mental disturbance, lack of ability to concentrate, to think logically, to pay attention. One can therefore expect to find high intellectual development only in an organism whose 'milieu intérieur' has become fixed, so that the intellectual ascendency of man with his "vie libre" is conditioned by the fixity of his internal environment.

It has been pointed out [42] that when Sir Michael Foster, the great English physiologist, wrote the life of Bernard thirty-five years ago, he made no mention of the doctrine of the 'milieu intérieur,' but today, J. S. Haldane,[43] quoting Bernard's sentence, "All vital

[39] Henderson, L. J., *Blood: A study in general physiology.*

[40] Cannon, W. B., *The wisdom of the body.*

[41] Bernard, C., *Phén.*, I, p. 113.

[42] Fulton, J. F., Claude Bernard and the future of medicine, *Can. Med. Ass. J.*, 1932, xxvii, 427.

[43] Haldane, J. S., *The philosophical basis of biology*, p. 72.

mechanisms, however varied they may be, have only one object, that of preserving constant the conditions of life in the internal environment," [44] claims that " No more pregnant sentence was ever framed by a physiologist "; and John Fulton predicts: " The future will show that this idea is as important for physiology as evolution was for biology." Perhaps the idea of the dynamic equilibrium of the organism, with an external as well as an internal pole of balance, is the architect's drawing of the bridge which will eventually unite the organic with the physical world.

Before I leave the matter, I should like to quote what Bernard himself predicted for his theory. He said in 1864:

" If it happens some day that by virtue of patience and hard work, physiology does definitely become established as a science, then we shall be able by modification of the internal environment, i. e., the blood, to exercise our will on all this world of elementary organisms composing our body; when we know the laws which control their diverse relationships, we shall be able to regulate and modify to our taste vital manifestations." [45]

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[44] Bernard, C., *Phén.*, I, p. 121.

[45] Bernard, C., *Sc. exp.*, Le curare, p. 314.

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THE PATHOLOGY OF SYPHILIS AS REVEALED BY AUTOPSIES PERFORMED BETWEEN 1563 AND 1761 *

E. L. ZIMMERMANN

In *Janus* of 1934 was published a study of the early pathology of syphilis, based chiefly on accounts of autopsies performed between the years 1497 and 1563. The year 1563, in which Botallus published his description of an autopsy on a syphilitic corpse with gummatous necrosis of the skull and meningitis, was selected as a terminal point entirely on an arbitrary basis. It might be said that the period between 1497 and 1563 embraces the material assembled in the Aphrodisiacus of Aloysius Luisinus (1566-1567) and that the appearance of this collection of syphilologic treatises marks, in a sense, the end of the initial era of feverish investigation consequent to recognition of syphilis as a new disease entity. The period was climaxed by the contributions of Fracastor, Fernel and Falloppius. By the second half of the sixteenth century, a clearer insight into the nature of this *hydra* had been gained. It had become a venereal disease, a *morbus venereus* (Béthencourt, 1527), a *lues venerea* (Fernel, 1546).

The theoretical pathology of this earliest period, with the lone exception of that of the iconoclast, Paracelsus (and his influence on medicine during his lifetime was trivial), is founded upon the humoral doctrines of Graeco-Roman medicine, derived either directly from original sources, as was the case with humanist-physicians, so-called *medical philologians*, such as Nicolaus Leonicenus and Joannes Manardus of Ferrara, or as transmitted through the more or less garbled translations and compilations of Arabian and scholastic authors. By the end of the sixteenth century, the blunt but pregnant teachings of Paracelsus were reaching attentive ears. There arose the iatrochemical school, culminating in the figure of the Leyden professor, Franciscus Sylvius (de la Boë) (1614-1672). On the other hand, there were the disciples of Descartes, the iatromechanical school, who sought to explain the phenomenon of life on the basis of physical principles. In the late seventeenth and eighteenth cen-

* From the Syphilis Division of the Medical Clinic, The Johns Hopkins Hospital.

turies, even more intricate systems were formulated (Stahl, Friedrich Hoffmann, Cullen, Brown). Such speculations in pathology were not always to the benefit of the unfortunate syphilitic. Witness the pathetic venereal sufferers who were fed tremendous doses of opium daily over long periods on the basis of an idle theory which has burst like a bubble. But these schools and systems concern us only in so far as they apply to the interpretation of autopsy findings. Here interest is centered in dissections of syphilitic corpses, performed between 1563 and 1761, the year in which was first published Morgagni's *De Sedibus et Causis Morborum*. To a certain extent, valuable pathological knowledge, especially of bone syphilis, was obtained from the surgical treatment of the disease. Some such observations have been included.

As in the case of disease in general, so in syphilis, a semeiology for involvement of the inner structures was established, not on the basis of disease of the separate viscera, but of vitiation of one or more of the three bodily functions. In other words, attention was focussed on disturbances of function rather than on any definite focal organic lesion. Such an attitude toward the interpretation of symptoms was a natural outgrowth of humoralism. True, Fernel had stressed the importance of pathologic anatomy in localizing the seat of disease processes. He distinguished sharply between the cause of disease and the disease itself, identifying the former with the humors, and the latter with changes in the solid parts. Symptoms were explained on the basis of functional alterations. Defects of vital function would correspond, in a rough way, to cardio-respiratory symptoms in the modern sense; of animal function, to those of central nervous system disease; of the natural function, to gastro-intestinal symptoms. A paradigm of such a semeiology with its pathological background is contained in Jean Astruc's *De Morbis Venereis* (1736). Astruc was at heart a thinker, a scholar, as evidenced by his splendid contributions to medical bibliography and history, by his valuable critique of the Pentateuch. He was not of the kidney to lend his hand to dissection. He built up a pathology for syphilis, not with the help of a corpse and a scalpel, but through the instrument of his own brain and a pen. As to autopsies on syphilitics, there is not one word in the first tome of his work, which is

devoted to the presentation of his own conceptions of the disease. True, in the second tome (1740), mainly bibliographic in nature, he does refer to autopsies performed by Alexander Benedictus, certain Ferrarese physicians,[1] Nicolaus Massa, Severinus and Dordonus. In the first tome, six brief pages are devoted to *laesiones functionum*, which in a modern textbook would represent the section on visceral syphilis. To illustrate our point, defects in animal function consequent to syphilis, such as vertigo, epilepsy and paralysis, were ascribed to a motley group of pathological lesions, some real, some fanciful. He does mention exostosis and caries of the skull, nodes involving the meninges, gummata within the brain, all lesions described, as will subsequently be related, by his predecessors in actual dissections. But he adds such old figments as inspissation of lymph in the nerve trunks as a cause of paralysis, scirrhous tumors of the hypophysis preventing the escape of lymph from the ventricles with the production of hydrocephalus as a cause of syphilitic headaches. In short, he does not strive to establish a specific pathology for syphilis, based on actual observation, but musters the various causes to which each symptom has been ascribed in connection with disease in general, and, without second thought, applies them to the interpretation of symptoms occurring in the special disease he is investigating. This criticism of Astruc's approach toward unravelling the pathology of visceral syphilis holds for most authors of the period under consideration.

The question might be raised as to the sources from which accounts of autopsies have been obtained. Most of the material originates from two types of sources. On the one hand, there are the attempts at composing what, in a crude way, corresponds to our modern pathology. Of special importance in connection with syphilis, are the works of Schenck, Bonet and Morgagni. On the other hand, there are treatises devoted to investigation of some special part of the body, or to some special symptom or syndrome; for example, the *De Anima Brutorum . . . Exercitationes Duae* of Thomas Willis (Oxford, 1682) for findings in cerebral syphilis;

[1] The celebrated autopsy on a syphilitic with effusions into both knee joints, mentioned by Sebastian Aquilinus, Wendelinus Hock and Georg Vella. See my study in *Janus*, 1934.

the *De Subitaneis Mortibus Libri II* (Rome, 1707) and the *De Motu Cordis et Aneurysmatibus* (Rome, 1727, posthumous) of Lancisi for clinical descriptions of aortic syphilis. A third, but far less fruitful source, are the various *centuriae, observationes, exercitationes, dissertationes, historiae,* etc., collections chiefly of clinical experiences, but occasionally yielding some pathological finding. I have examined some fifty works of this character published from the middle of the sixteenth century to the time of Morgagni's work (1761), and with only too disappointing regularity, found only barren soil as far as the pathology of syphilis is concerned.

The *Observationum Medicarum Novarum, Admirabilium et Monstrosarum Volumen* (Basle, 1584) of Johann Schenck von Grafenberg of Freiburg in Breisgau, hereafter referred to simply as Schenck, contains considerable on syphilis. Among other autopsies, those by Alexander Benedictus, Nicolaus Massa, Bernard Tomitanus and Jean Fernel, all described in my previous publication, are summarized in his section on *lues venerea.*

In Theophile Bonet's *Sepulchretum Sive Anatomia Practica* (Geneva, 1679), extolled by Haller as an ' immortale opus, quo solum pro pathologica bibliotheca sit,' a mortuary of nearly three thousand necropsy protocols with comments (scholia) appended, the material has been extended to cover another century. There is nothing original, on syphilis at least, in Schenck and Bonet. They are not investigators, but compilers. As is usual during the infancy of any scientific interest, there is little space for phenomena of daily interest. It is the rare, the miraculous, which is being ferreted out. Morgagni, as will be subsequently related, deplores the shabby treatment tendered syphilis in the *Sepulchretum.* But in all fairness to Bonet, the fault is not his. He had but meager sources to draw on. The last years of his life were entirely devoted to the labor of assembling the material for his mortuary. And he made a thorough job of it.

It is in Morgagni's *De Sedibus et Causis Morborum per Anatomen Indagatis Libri Quinque* (Venice, 1761) that an attempt is first made to base a pathology on original investigations. In this remarkable work, first published when Morgagni had attained the venerable age of 79, are presented the experiences of his esteemed teacher,

Valsalva, of a few of his colleagues as well as his own. What is of fundamental importance, commonplace conditions are studied and an attempt is made to correlate clinical history with autopsy findings. An insight into the high purpose of his work is gathered from the following excerpt taken from the preface of his book:

"I am presenting previously unpublished observations, many coming from Valsalva, not a few from friends, but by far the greatest portion are taken from my own experience. In each chapter, I have given first place to Valsalva's observations, both because of their merit and to do him honor. All these, collected with the same care with which he assembled them, and when written in Italian, translated into Latin, all rewritten as I know he himself would have wished, I have published with such an eye to faithfulness that where I was in a quandary as to whether I had fully understood, I preferred to reproduce his very words, never omitting or adding, unless it were something from his own lips, as occurred in a few observations which he did not write, but carefully narrated to me.

"As to my own observations, I have minutely described each one as to the year, month, place, those present or assisting, unless I had already stated such in another passage. I have not only made note of the age, sex, but as far as possible, of other data, such as Peyer [2] asks his patients, also such as concern treatment. . . ."

In my previous study, it was shown that the earliest *anatomiae* on syphilitic corpses were interpreted as establishing or refuting four contentions pertaining to the pathology of syphilis or to its treatment: the question as to the reaccumulation in various parts of the body of metallic mercury, especially when inuncted (within necrotic bone, the calvaria, the joint cavities); the question as to the existence of visceral syphilis; the rôle of the liver in the pathogenesis of syphilis; the rôle of the phlegm, especially in the production of bone and joint syphilis.

These same questions continued to disturb the minds of those who 'anatomized.'

I. As to the finding of deposits of mercury within the body, fantastic tales continued to be manufactured. To mention but three.

[2] The Swiss Johann Conrad Peyer (1653-1712).

Petrus Castellus [3] reports an autopsy on a woman dying in the Hospital for Incurables in Rome "who had on several occasions used mercurial inunctions and subsequently developed such a heaviness of her head that even when she turned it slightly to one side, she immediately sensed a great weight. Nor could she raise her head except with the aid of her hand. On section, two ounces of mercury were found within her skull." Yet more startling is an experience communicated by Lorenz Scholtz [4] to Schenck. In an individual who had frequently inuncted himself with mercury, the metal at length became lodged within his veins. When the arm was raised, the mercury could be seen to flow downward, when it was again lowered, the metal flowed back to its original position. Of this he was cured by the juice of the pimpernel!

Finally an observation by Georgius Garnerus, also recorded by Schenck:

"Vicentius Boniventus, patrician of Clodia, from his youth addicted to all sorts of carnal excesses, whence he was, so to speak, consumed, yet so arrogant that he considered everyone else boorish and vulgar compared to himself, after five times drinking of decoctions of the sacred wood (guaiac), of sarsaparilla, of mechoachan,[5] and after having been three times inuncted without avail, finally placed himself into the hands of a female quack, who pretended to practice medicine. She treated this fellow, worthy of such a fate and deserving such treatment, with poorly 'extinguished' mercury and other corrosives in such a fashion that a violent inflammation of the palate, the cribiform plate, the pillars of the pharynx and the adjoining parts led to gangrene and a cancerous state, so that he cast up matter from the decayed parts, first from his windpipe and neighboring structures, finally he reached a point where he spued up with the

[3] Pietro Castelli (d. 1656), professor at Rome, Padua, then at Messina. His contributions to syphilis are insignificant.

[4] Laurent Scholtz (1552-1599) of Breslau. He was distinguished for his work as botanist as well as physician. Among other works he published *Catalogus Arborum, Fructicum ac Plantarum . . . Horti Vratislaviae* (1598).

[5] Described by Nicolaus Monardes in his medicinal herbel of the New World (1st ed. Spanish). In John Frampton's translation of 1577: "It (the plant) is brought from a countree that is beyonde the greate Citie of Mexico more than fortie leagues, that is called Mechoacan. . . ."

foulest of stench the brain itself. Which is indeed astonishing as Hippocrates says, if the bladder, brain or heart are wounded, death is inevitable. . . . Visited by so merited a punishment, the foresaid Vincentius continued to gurgle his wine along with the whorish medicine. Finally, in the midst of a debauch in a low tavern, unbeknown to his people, he died a wretched death. Being at that very time summoned to Clodia in a professional capacity, I was given full authority to open the body. So, no objection being raised and with the consent of his friends and relatives, after celebrating the proper funeral rites, I placed the body near its tomb and in the presence of Marco de Nigris of Clodia, a fellow physician and much cherished colleague, I sawed open the skull with the aid of the sexton. As best I could, I freed the membranes. Whereupon there arose an unendurable stench. But led on by great perseverance and curiosity, I cut away with a large knife the upper portion of the brain. Though the ventricles could scarcely longer be distinguished, I managed to collect in a goblet a considerable quantity of mercury, which I have preserved to this day. At length, overcome with nausea because of the frightful stench, I gave the body over to the sexton for burial."

More of this fellow Garnerus later.

So persistently was this phenomenon reported, even by the most reliable of physicians, that Virchow in 1858 remarks that there are 'ganz glaubwürdige Gewährsmänner' who report finding mercury within bones and reviews the question without coming to a definite conclusion (His *Archiv*, 15:224. 1858).

II. The physicians of the period under discussion had not the least doubt as to the existence of visceral syphilis. As will be subsequently related, it was John Hunter who again raised the issue.

III. Though the theory of the hepatic origin of syphilis, which supposed the fundamental lesion of the disease to be a *solutio continui* of the liver, an actual ulcer or abscess of this viscus, had been emphatically and convincingly rejected by Botallus, there continued, from time to time, echoes of this bitter controversy. Bonet again reviews the pros and cons. He cites the previously quoted autopsies of Alexander Benedictus and Bernard Tomitanus. He adds two

observations from the *Practica* of Hieronymus Cappivacius.[6] In the first instance, there occurred an ulcer of the liver resulting from *morbus gallicus*. In the second, in an 'alumnus of the shepherd Syphilus,' a dropsy developed as the result of a sorely diseased spleen. Though the substance of the liver was intact and its color normal, the viscus was destitute of any tunic, its surface appearing as though it had been gnawed by rats. This presumably was the result of numerous hydatids which had ruptured and discharged their serum or lymph into the abdomen, thus stripping the liver of its tunic. Then again there is Conrad Gesner's account of a youth who suffered great pain in his right side. "After death, a scar was noticed in the region of each knee, whence is was presumed that he had been infected with the French disease. Upon opening the body, it was discovered that he had also suffered internally from syphilis. There were numerous ulcers (pustulae) on the diaphragm. In the region where the pain had been greatest, the stomach showed an ulcer (pustula) the size of the hollow of the hand. In the adjacent part of the liver, there was a similar ulcer, one ulcer being superimposed upon the other."

On the other hand, Bonet counters with instances of the French disease, in which at autopsy the liver was found to be normal. Thus Joannes Rhodius[7] tells of the finding by Andreas Spigelius of a normal liver in a girl of twelve, who died as a result of buboes which could not be induced to suppurate. Again, the younger Riolan[8] offers a similar experience. Commenting that the liver, the source of all lust, was by some considered to be the seat (*sedes*) of *lues venerea*, he relates that in 1632, he "dissected publicly in the medical schools of Paris, the body of a very beautiful prostitute, in which all the viscera concerned with the function of nutrition (so the liver), were found to be sound. Yet her cranium was eroded in several places and there was an exostosis of the left tibia."

[6] *Methodi Practicae Medicinae* (1574) of Jerome Cappivacio, professor at Padua. From a financial standpoint, at least, he was a most successful syphilologist. Like his predecessor and countryman, Berengario da Carpi, he amassed a great fortune (18,000 crowns) by treating syphilis. Proksch drolly remarks: "Seine *Acroaseis* (lectures) *de Virulentia Gallica* sind jedoch keinen Heller werth."

[7] Johann Rhode of Padua. *Observationum Medicinalium Centuriae*, III, 1657.

[8] The younger Riolan, bitter antagonist of Harvey.

Morgagni's discussion of the question of liver syphilis is well worth quoting. Commenting on the case of a butcher with aortic syphilis, to be described later: (Epist. LVIII, sect. 13 and 14.)

"Four structures, the lungs, the aorta, the kidneys and their appendages [9] are often found diseased in those who have suffered long and grievously from the disease, a fact one would not judge to be true upon perusing many authors. That viscus, however, which even the most learned physicians formerly thought injured above all others and to be the seat of the disease (you will see by turning to the *Sepulchretum* that I am referring to the liver), has never, as far as I can at this moment recall, been observed by me to be diseased in such bodies.[10] The objection might be raised that what I have found to occur rarely or never, might nevertheless be of frequent occurrence in the experience of others and *vice versa.* I am merely stating what changes have been encountered in my own experience, fully aware that the scourge at times lurks under the mask of any disease whatsoever, and so can involve any viscus. The relative frequency with which various organs are involved can only be determined when the many observations of many investigators have been assembled. I marvel that though so many are infected and die of the disease, yes, still are dying of it, yet dissections up to the present time are by no means correspondingly numerous. Certainly you do not find many such accounts in this section of the *Sepulchretum.* Brief as is this section, it is not even entirely devoted to *lues venerea,* but includes *plica polonica.* Moreover, the section given over to this disease consists in great part of *scholia* (glosses) . . . and these *scholia* are chiefly from *Sylvius* (de la Boë) who attempts to prove the acid nature of the (syphilitic) virus."

[9] It must be remembered that the identity of gonorrhea and syphilis was during Morgagni's lifetime universally accepted. The scarring of the urethra and other residual effects of an old urethritis were considered evidences of a past syphilitic infection. *Lues Venerea* included gonorrhea, chancroid and syphilis. Thus the *Lues Venerea* of these earlier authors is not synonymous with our present day term syphilis.

[10] In fact, Morgagni does mention liver changes (enlargement, induration, scarring, a blackish discoloration) in certain of his autopsies on syphilitic corpses. But he is not impressed as to the rôle of the liver in syphilis.

IV. The old phlegm theory of Sebastian Aquilinus, Nicolaus Massa and Fracastor found little favor during this period.

. . . . . .

All these conceptions and speculations are mere continuations of threads which reach back to the infancy of syphilis in Europe. The real contributions to pathology lie in a different direction. They are discussed according to some special organ or structure involved: the respiratory tract (larynx, trachea and lungs); the lymph glands; the skeletal system; the cardiovascular system (especially the aorta); the brain. These various accounts have been presented in the form of translations, as close as possible to the Latin text, even at the cost of a certain clumsiness of expression.

Naturally, there are many distorted and exaggerated accounts of post-mortem findings. A few of these worthless but representative tales have been reproduced. Some of these blustering fellows are more concerned about the stench of the corpses than about their dissection.

As an example of the futility of some of the investigations may be cited those of Giacomo Vercelloni (born 1676), who, if we may believe him, dissected more than a hundred syphilitic corpses within three years at the Hospital for Incurables at Rome. He is soundly belabored by Astruc, Morgagni and Proksch. The last mentioned comments: "One would at least expect that Vercelloni would contribute to the knowledge of visceral syphilis. But such is not the case, though he constantly claims to discover the disease in the thymus gland." Matthias Tilling[11] had noted several instances of enlarged and abscessed thymus glands in syphilis. Vercelloni bluntly retorts: "Let Tilling say what he may. Never have I seen the thymus abscessed. During the three years in which I dissected more than a hundred such corpses, I surely should have met with such a finding. I have in every instance found the gland hard, shrivelled, reduced to nothing but scirrhus as are the other glands. . . ." An observation certainly dependent upon a well recognized physiological process.

As to the brain: "In syphilitic corpses, the cerebral cortex has

[11] Matthias Tilling (d. 1685), professor at Rinteln.

constantly been found by me to be flaccid, moist, as if undergoing putrefaction. In the ventricles of such brains, I have also observed to fluctuate a yellowish fluid similar to that which will presently be described as found in the outer parts. In the sinuses of these brains, there were present many polyp-like bloody excrescenses, black, floating in the serum. Finally, the pia appeared decayed, livid, furrowed by blackish vessels, so fine as almost to escape detection. These findings explain why those subject to the disease are prone to squint, stuttering, torticollis, spasms, convulsions. . . ."

Morgagni (Epist. LVIII, sect. 15) does not mention Vercelloni by name, but he ridicules his *De Pudendorum Morbis et Lue Venerea Tetrabiblion* (1716). How can a fellow who places the uterus between the rectum and vagina, who encloses the inguinal glands within the peritoneum, in short who does not know normal anatomy, attempt investigations into pathological anatomy?

I. Respiratory Tract

Prone as is the upper respiratory tract to the ravages of syphilis, it is not surprising that such lesions are frequently mentioned. There were the disfiguring nasal gummata, which tested the ingenuity of the plastic surgeons. As early as 1554, the Nuremberg surgeon, Franz Renner, devised obturators, preferably of leather, to aid the unfortunate syphilitic with palatal perforation so that "einer nicht mehr so nüselt (näselt) und durch die nasen red," a speech defect so characteristic of syphilitic destruction of the palate.[12] Shortly afterwards, Amatus Lusitanus in his *Curationes Medicinales* describes an obturator which he devised for a certain Greek nobleman. Ambroise Paré, in his *Methode Curative des Playes et Fractures de la Teste* (tête) *Humaine,* also describes a device for those who "ont le palais troüé avec deperdition d'os, qui est cause de les faire parler *renaud.*"

There is an account by Massa of a nobleman with a syphilitic fistula extensive enough to allow the tracheal wall to be seen and palpated. To make himself audible, the sinus was stuffed with a silk sponge.

[12] For a discussion as to the priority in devising an obturator for gummatous perforation of the palate: Karl Sudhoff, "Vom Alter des Gaumenobturator, *Janus* 28: 1924, p. 451.

Morgagni (Epist. 44, sect. 15) records an extensive lesion of the upper respiratory tract in a " decrepit old fellow, who had suffered many years from *lues venerea,* so one could hardly understand his speech, and who for the past twelve years had complained of difficulty in urination and gonorrhea. Slowly wasting away from these ills and old age, he passed away the middle of January, 1717. Dissecting certain parts of his body in the hospital, we noted what pertained to the forementioned diseases. The uvula, part of which was destroyed, also the upper surface of the back of the tongue, and the cartilage united by the ligament of the epiglottis, were so cicatrized that only scar tissue remained. Thus this cartilage, irregularly contracted, formed a sort of triangular vertex, more like that of the dog than of man. Indeed, the disease had extended to the rest of the larynx and to the adjoining part of the trachea. Both arytenoids were as if loosened, not parallel to each other. Within the trachea protruded large, irregular tendon-like structures."

Under Morgagni's discussion of phthisis (Epist. XXII, sect. II), lesions of unquestionable tuberculosis are ascribed to syphilis. In commenting on the autopsy findings in a syphilitic corpse presenting such lesions, he remarks: " Moreover, *lues venerea,* which originally caused this man to become prone to diseases of the chest, had rendered the lungs more liable to corruption. Certain it is that phthisis grafts itself upon *lues venerea.* Both clinicians and anatomists are well aware of this." He describes two consumptive prostitutes. The first became so emaciated as a result of a long-standing ' venereal fever ' that no trace of her breasts remained except the nipples (a sign of phthisis described in antiquity by Aretaeus the Cappadocian). The second, observed by Valsalva, presented the classical post-mortem findings of pulmonary tuberculosis with cavitation. Valsalva had noted the predilection of phthisical abscesses (cavities) for the upper parts of the lungs. This prostitute had been ailing for months with a low-grade fever, progressive cough, then dyspnea and copious and bloody sputum. At section, there were found in the lungs, adhesions of an old pleurisy, scattered tubercles, in the upper lobe of the right lung a great cavity (*ingens excavatum ulcus*), and in the left lung, a pear-sized indurated lesion with a small central cavity full of pus.

II. Lymph Glands

Naturally one of the earliest described lesions of syphilis was the inguinal adenitis regional to genital chancre. As noted in my previous study, the baneful significance of an indolent adenitis in contrast to a suppurating adenitis was likewise early appreciated. With the doctrine of unity of chancres prevailing, the suppuration of the inguinal glands consequent to certain genital lesions was very welcome to these early syphilologists. These "good fat buboes," as Botallus lauds them, were interpreted in the sense of successful evacuation of peccant humors. This supposedly aborted syphilis of the early physicians is our chancroidal infection.

The polyadenitis of the early secondary period, involving the axillaries, cervicals and post auriculars, was noted by Zacutus Lusitanus in 1629 and again by Gervais Ucay in 1699.[13]

Marcus Aurelius Severinus reports the frequent involvement of the lymph glands in syphilis. The following passages are from his *De Recondita Abscessuum Natura,* on the hidden causes of abscesses (1632). Severinus applied the term abscess in an entirely different sense from present day usage. It corresponds to our word, tumor, for he includes cysts, neoplasms, adenitis, bronchocele, hydrocephalus, etc. An aneurysm is an *abscessus sanguifluus.* He describes syphilis as a "*morbus totus abscessorius,*" preeminently a tumor disease (gummata, tophi, etc.)

According to Severinus, there is no definite *sedes* for the disease. The infection is dispersed throughout the blood and humors. Among the solid parts, it lodges first in the skin, then deeper in the flesh and membranes. Fabius Pacius,[14] in his commentary on the French disease, denies the contention that the various glands of the body are the structures basically involved in syphilis, the *adaequatum subjectum,* to use his technical term. With this opinion Severinus

[13] Zacutus couches the subject under discussion in the form of questions. In the first of the twelve books of his *De Medicorum Principum Historia,* in which he treats of *Morbus Gallicus,* he puts the query: quod bubo Gallicus non solum in inguinibus, sed retro aures aut sub alis (i. e. in the axillae) apperere possit? He answers in the affirmative.

[14] Fabius Pacius of Vicenza, 1547-1614. *Tractatus de Morbo Gallico per Methodum Curando,* 1604.

agrees. However, in inveterate syphilis, disease of the glands is a frequently observed phenomenon. "Indeed as often as we have dissected bodies of syphilitics, certainly in great numbers, we have found these parts diseased in almost all."

In another passage Severinus points out enlargement of a group of glands in the groin other than those usually described in regional adenitis. Possibly they are the result of unusual distribution of lymph drainage or the expression of generalization. The entire passage is quoted as it reflects the crowding of hospitals with venereal patients, also that autopsies on such patients were much more frequently performed during the early seventeenth century than surviving records would indicate.

"Several men of prominence, such as (Alexander) Benedictus, Fernel, Laurentius Joubert and Conradus Tigurinus (Gesner) inform us that during life as well as in carefully dissected corpses, the viscera are constantly found diseased with phymata, abscesses and ulcers similar to the papules, nodes and tubercles occurring in other (i. e., the outer) parts of the body. Nicolaus Massa goes even further. He reports the veins of syphilitic corpses full, not of blood, but of a whitish phlegm, and the muscles which were painful during life, drenched in the same thick white phlegm. All this struck me as most remarkable until I confirmed it in the course of time. Possessing the privilege of dissecting in a hospital, more crowded with victims of syphilis than of any other disease, and spurred on by an eagerness to make new discoveries, I seized every opportunity to dissect. Among those suffering from syphilis, I found many in whom the oesophagus and trachea were ulcerated, whose lungs and liver were full of pustules, whose prostate showed imposthumes. In the body of one, who had been hanged and whose corpse I dissected in December, 1631, in the public anatomical theatre in Naples, it was found that the left vas deferens, where it bends over the inguinal ligament (super interfeminio) to the penis, was partially buried under glands occupying this region. Inasmuch as this man had had suppurating syphilitic buboes, it was the immediate opinion of all that these glands were affected with syphilitic 'abscesses,' a condition as yet undescribed in reports dealing with newly discovered phenomena."

III. Bones

It is noteworthy that the first recorded autopsy on a syphilitic deals with bone syphilis (Alexander Benedictus, 1497). Today we seldom encounter the repulsive, destructive forms of skeletal syphilis so frequent several centuries ago. Witness Ulrich von Hutten's gumma-riddled body, the cranial necroses described by Falloppius, Botallus and Morgagni. Ingrassia [15] tells of dissecting the corpse of a man who died of *lues venerea* in the Hospital for Incurables in Naples. The breast and collar bones along with some of his ribs were involved by large tumors, which, upon rupturing, exuded much foul pus. When these were drained, a great sinus came into view. Georgius Dordonus [16] cites an autopsy performed at the University of Pavia, on an individual who for years had suffered from ulcers of the forearms and head. The bones of the left forearm were found to be necrotic down to the very marrow, the skull to the inner table.

An observation of Pietro de Marchetti [17] is quoted as it illustrates the successful surgical treatment of gummatous necrosis with sequestrum formation. Under the caption: "Excruciating headache of syphilitic origin without [external evidence of] gummata in a septuagenarian; frequent operation (*terebratio*, boring), with remissions and recurrences, often with most alarming symptoms; finally complete cure by such treatment":

"The head suffers from many other diseases, especially from syphilitic gummata and pains. I recall a seventy year old cobbler who suffered the most excruciating headaches resulting from *lues venerea*, but without gummata. A consultation of physicians was unanimous in the opinion that one should risk opening the skull over the coronal suture, by which procedure he was relieved of pain for some time. In the course of three or four years, he again developed headache, this time associated with stupor and mental symptoms. These recurred at intervals, with pain in front of the bregma, almost at the forehead.

[15] *De Tumoribus Praeter Naturam*, 1553.

[16] Georgius Dordonus, *De Morbi Gallici Curatione Tractatus Quatuor*, 1568.

[17] Pietro de Marchetti (1589-1673), professor at Padua. *Observationum Medico-chirurgicarum Sylloge*, 1664.

" So I first cut the skin in the form of a cross and found the bone completely decayed. When this was bared, there flowed forth a great quantity of pus, whereupon the patient some days later was entirely relieved of his symptoms. He presented for many months an open sinus, for the bone had rotted and the flesh could not grow up from the marrow and fill it in. A year later, he again commenced to suffer most excruciating headaches, to relieve which I bored another opening not far from the first, where I felt the bone to be moveable. Having again drained off the pus, I once more relieved him. Two or three months later, he lapsed into a deep lethargy, whereupon I was again summoned. Upon exploring the bone with a probe and feeling it loose, I removed a piece of bone the size of a *scutate*, completely decayed, as if it had been buried in the earth for ten years. At the base of the ulcer, no membrane could be seen, but some rather hard, reddish, smooth tissue. To such an extent was the dura and brain exposed that I feared for his life. On the next day, much purulent matter flowed forth and he awoke from his deep sleep. Over the meninges, which were covered with a flesh-like substance provided by nature, I placed a red silk cloth as a protection to the brain, at first without any local applications. Subsequently, when neither pus nor other matter was observed on that tissue, I applied the *ceratum barbarum*.[18] As a result of which procedures, the patient survived more than ten years without a recurrence of headache."

According to humoral pathology, provident nature protected the vital organs, the *partes nobiliores*, by diverting excessive or corrupt humors from these parts to the less important structures, to so-called emunctoria, " cesspools," as they were dubbed. Thus the cervical, axillary and inguinal glands were emunctories for the brain, heart and liver respectively; the skin served as an emunctory for the entire body; the bones and joints, for the excessive phlegm about the brain. As a result of such a protective flux, descending from the brain via the nerves, gummatous periostitis originated. That there was early appreciation of the fact that the striking lesion of osseous syphilis is a periostitis is shown by the surprise expressed

[18] A complex plaster for " bloody sores and for promoting the formation of callus in fractures." See Paulus Aegineta, Book VII, Sect. xvii.

by Alexander Benedictus (1497) in finding a syphilitic bone with its periosteum intact. This first of recorded autopsies on a syphilitic corpse reads: "It is nothing new for bones to putrefy. But it is astonishing for abscesses to develop within them, as we recently observed upon dissecting the corpse of a woman dead of the French disease. Upon investigating the cause of her disease, we found the periosteum intact, though the underlying bone was swollen and suppurated to the medulla." There persisted, indeed, a widespread belief that all gummata were periosteal in origin. The question is thoroughly discussed by Morgagni two and one-half centuries later (Epist. XVIII).

"A man of Bologna suffered severely from syphilitic pains which, for a period of time, recurred daily. These were located in the shaft of the tibia, but were most intense at the malleolus, where a small, rather soft tumor could be seen and palpated. Having administered internal and external remedies in vain, Valsalva had recourse to the knife. Separating the integument, he removed a small amount of yellowish gelatinous matter which lay between this and the underlying sinews and formed the tumor. On the following day, there was no recurrence of the pain at the malleolus. However, when the adjacent tendons were pressed, the patient continued to complain of a sensation as though he were being pricked by fine needles. This was readily explained on the basis that some of the gelatinous matter still remained in this region. Taking care not to injure the tendons, all such matter was skillfully and painstakingly removed down to the very bone, whereupon the pricking sensation disappeared. Contrary to expectation, the pain continued in the tibia, for it had first been thought to originate from sympathy. So with the aid of a scalpel, the periosteum was exposed and found to be somewhat damaged, though when separated, the underlying bone was observed to be everywhere sound. Thereupon, all pain having disappeared and the wound having fully healed, the patient was discharged as cured. When Valsalva related this observation to me, I recall that he commented that he had on other occasions and for similar reasons successfully removed such syphilitic tumors, without recurrence of pain or tumor. He also expressed the opinion that not all of these so-called syphilitic gummata arise under the periosteum or are in-

cluded in this particular tunic. Exactly like the observation just related is one by Fabricius ab Aquapendente, elsewhere cited in this work, except that the tumor was near the carpus instead of near the malleolus. At certain hours each day, it caused sharp pains. As revealed by the knife, it was composed of small concretions of clear phlegm, which impinged upon the deeper tendons. I believe it was Nicolaus Massa, in his dissection of numerous corpses of individuals suffering during life from syphilis, who designated the material as such. As you will observe in the *Sepulchretum*, Massa states he found painful areas drenched in a phlegm-like material. This same substance Fracastor also claims to have found in his dissections to be the cause of the nocturnal pains occurring in this disease. He terms this glue-like humor, found upon tendons and muscles as *lentor,* and describes these *gummositates,* as he elegantly terms them, as being composed of thickened phlegm. It does not matter that Fabricius does not state that the tumor excised by him was syphilitic. He well knows that gummata, though not always, yet most frequently originate from this disease. Whether two such distinguished anatomists and surgeons as Fabricius and Valsalva were mistaken when they expressed the opinion that tendons as well as periosteum are involved in these pains, I prefer to leave to your judgment. But confining ourselves to this section of the *Sepulchretum,* you can readily be convinced that gummata are not always lodged between periosteum and bone from a statement of Rhodius who saw Antonius Molinettus [19] demonstrate in this very amphitheatre of ours, upon opening a skull, three glistening white gummata, which were attached to the dura. Also from Guarinonius,[20] who claims to have found gummata embedded within the brain substance itself. Such a localization I recall all the more vividly because these statements are appended to an observation, in which three tumors, active gummata (*gummata virentia*), were said to have been found within the brain of a man afflicted with syphilitic epilepsy."

[19] Antonio Molinetti, d. 1673, professor of anatony at Padua, *Dissertationes Anatomiae et Pathologiae de Sensibus,* 1669; *Dissertationes Anatomico-Pathologiae,* 1675. I have searched the former, but found no mention of this autopsy.

[20] Christopher Guarinonio.

An autopsy by Morgagni (Epist. LVIIII) exemplifies the remarkable ability of the dura mater to wall off the brain from extensive syphilitic osteomyelitis of the calvaria:

"In the Hospital for Incurables, there lay a bedridden old hag, in whom the bone of the left sinciput and of the occiput had been so eaten away by syphilitic caries that the brain was exposed through an aperture three fingerbreadths wide, and when the artery at the wrist was felt, one could perceive that this and the brain expanded and collapsed simultaneously. Lest you doubt my word, I might state that I observed her many times during that year, if I recall correctly, during 1700. For the woman was confined there over a considerable period. In spite of the fact that the eroding virus was not thoroughly destroyed and the ulceration bordering the aperture could not be made to cicatrize, the membrane covering the brain could be seen glistening and sound.

"I was aware of the fact that when a carious process continues over a long period, the calvaria will be entirely eroded, which fact I have read in Falloppius, to mention but one such account. 'At times the entire sinciput is destroyed, at others, part of the occiput, again the whole calvaria. This I first observed in my maternal aunt, who had contracted syphilis from her husband. I removed the entire calvaria, and found the meninges covered by a sort of pellicle. There was a constant pulsation of the meninges. . . .' In my old woman, however, there was apparent no pellicle covering the meninges. When the dura was retracted, the brain was seen to be covered by the pia with its reddish, glistening moist surface. I could not marvel enough how this virus could have eaten away the bone, yet in no way injure this membrane, and that the woman did not suffer from convulsions, paralysis, or other symptoms of injury to the brain or meninges. Whether she had suffered from these at some previous time, I do not know."

Morgagni (Epist. LVIII, sect. 4) also records an observation of Valsalva pertaining to a 50 year old syphilitic woman whose lower extremities began to bend as though of wax. Upon moving her limbs, there was a crepitus loud enough to be heard by those near by. At autopsy, the innominates, femurs, tibias, bones of the vault

of the skull were found to be as flexible as parchment. On their surface, they were spongy, in places carious down to the medulla. (Osteomalacia in a syphilitic?)

I have appended two further accounts of skeletal syphilis, one from Marcellus Donatus [21] of a remarkable instance of spontaneous fracture in an old syphilitic with extensive destruction of the long bones, the other from Dodonaeus,[22] possibly what may have been syphilitic osteochondritis in a fetus.

Donatus: "Vincent Morellus, illustrious poet, equerry to the patrician Dionysius de Pretis, while in company with other Portuguese fellow servants, snatched half an orange from the table and hurled it at a companion who was running from him. Thereby, he harmed himself much more than he did the other fellow, for by the violent motion, the right humerus was fractured in such a fashion that, upon palpation, the ends of the bones could be felt to have separated. Scarcely had the bone mended, though he could not as yet move it as before, when awakening in the middle of the night, he reached down with his other arm for the chamber, by which effort he fractured the other humerus in its middle. Under treatment, this likewise healed. Years before, this man had suffered most cruelly from the French disease, his head, legs and arms were disfigured with tophi, which disappeared in the course of time under mercurial inunctions, whence his bones, so eroded and diseased by caries, became prone to such remarkable fractures."

Dodonaeus: "It is not rare in *lues venerea* for the bones to become fragile. In the museum of Marquard Slegelius is preserved the skeleton of a certain noble Venetian prostitute, consumed by *lues venerea,* whose epiglottis had been eaten away and who subsequently suffocated from food entering the trachea. Within her was found a male fetus, contaminated with the same disease, as a result of which, its bones had become carious."

[21] Marcello Donato, *De Medica Historia Mirabili Libri VI,* 1586.
[22] Rembert Dodoens of Leyden, *Observationum Medicarum Exempla Rara,* 1581.

IV. Cardiovascular System

If the American origin of syphilis be correct, little wonder that pre-Columbian medicine contains little or nothing on saccular aneurysm of the various vessels. Morgagni notes the silence of the older writers in respect to such aneurysms.

In an individual presenting a pulsating tumor dorsally near the vertebral column, Vesalius [23] diagnosed an aortic aneurysm. His diagnosis was confirmed two years later by physicians at Augsburg who found at autopsy an aneurysm the size of an ostrich egg, which was eroding the vertebrae and ribs. Fernel,[24] who has much to say on the subject of aneurysms, was the first to distinguish between the true and the false.

But it is Ambroise Paré who first suggests a causal relationship between aneurysm and syphilis. In his section *Traitant des Tumeurs Contre Nature en Général* there occurs the following significant passage:

"Aneurysms involving the inner vessels are incurable, and frequently occur in those who have had the pox and have been subjected on several occasions to a sweat cure. As a result, the blood becomes greatly heated and subtilizes, causing the contents of the artery to seek to escape, thus producing a dilatation of the artery, at times as big as a fist.

"Which condition I found in the corpse of a certain Belanger, a master tailor, living on the Pont Saint Michel, near the Sign of the Cock, who had a large venous aneurysm of which he suddenly died, . . . I anatomized him and found a great quantity of blood dispersed through the thorax, and the trunk of the *artère veineuse* so dilated that one could introduce a fist. Its inner tunic was of bony consistency. This I demonstrated before a considerable gathering of spectators in the schools of medicine in Paris, where my dissection caused great astonishment. This specimen I have preserved in my museum as a monstrosity. During life, Belanger suffered from a great throbbing of all his arteries, stating he experienced an ex-

[23] Letter of Vesalius to A. P. Gasser, dated Brussels, July 18, 1557.

[24] Fernel has been credited with recognizing the syphilitic etiology of aneurysms. I have examined his *Opera Omnia* but was able to discover no such statement.

treme feeling of heat throughout his body, often being seized with hot flushes. Monsieur Sylvius,[25] royal lecturer in medicine, had him stop his wine. In its stead, he was to drink pure boiled water. His food was of fresh cheese thoroughly churned. To the painful area, a cataplasm was applied. At night he partook of pot barley, to which was added some barley flour and poppy seeds. At intervals, he took cooling clysters of pure cassia. And Belanger informed me that he had been helped more by Sylvius than by all other physicians put together.

"The reason why such aneurysms become great and their walls bony lies in the fact that the boiling hot blood first causes the tunic of the artery to dilate and to enlarge. Finally it ruptures, taking unto itself substance from the adjacent parts to reform its wall, and accordingly there is formed a large or small tumor, in proportion to the capacity of the region involved. Little by little, the walls of the tumor dry out and harden, like a vessel which has become cartilaginous, indeed bony, because of a *material* and *efficient cause*,[26] just as stones are produced in the kidneys and bladder. For the peccant humor in the blood dries out and is solidified by the extreme heat, causing it to adhere to the tunic of the artery and the region involved. Thus it hardens and becomes bony. And that by God's great foresight (*Chambrière du Grand Dieu*) aiming to construct a rampart, a strong barrier, lest the hot boiling blood, teeming in spirits, flow forth from the tunic of the artery, dilated into an aneurysm."

There has been considerable controversy as to the vessel involved in this fellow Belanger. Malgaigne, in a footnote of his edition of the works of Paré, expresses surprise at the various interpretations of the term *artère veineuse*. Albrecht Haller has understood it as aneurysm of the pulmonary vein. Laennec[27] comments: "I know of only a single instance of marked dilatation of the pulmonary artery, the one reported by Parè . . ." Laennec believes, as did

[25] Jacques Dubois (1478-1555), teacher of Vesalius at Paris. Not to be confused with Johannes Sylvius of Flanders, a contemporary, whose *De Morbo Gallico* is included in Tome I of Luisinus' *Aphrodisiacus*.

[26] This standard conception of causes is derived from Aristotelian logic. *Physica*, II, 3, 7.

[27] Traité de l'auscultation, 2nd ed., T. II, p. 729.

Morgagni before him, that Paré meant the *veine arterielle,* i. e., the pulmonary artery. Malgaigne, on the other hand, insists that Paré himself in one place in his work states that there are two orifices to the left ventricle, one the *artère aorta,* the other the *artère veineuse,* and accordingly interprets it as one of the pulmonary veins.

The great pulsation of the peripheral arterial system in aortic insufficiency was strikingly described in 1715 by Raymond de Vieussens in his *Traité Nouveau de la Structure et Des Causes du Mouvement du Cœur.* He tells of one Jean Chifort, 30 years of age, with disease of the aorta and aortic valves, whose pulse struck the finger tips " autant que l'auroit fait une corde fort tendue et violemment ébranlée," like a cord tightly stretched and violently struck. So impressed was he by the throbbing that he adds: " I have never seen a similar affection nor do I ever wish to see one again." This type of pulse, which we designate as water-hammer or Corrigan, was described even before Vieussens by Francesco Bartholetti (1588-1630) in his *Methodus in Dyspnoeam, S. De Respirationibus Liber IV,* 1633.

There was a considerable lapse of time before the relationship of syphilis to aneurysm again draws the attention of pathologists. It is to the credit of Italian physicians that attention is again focussed on cardiovascular syphilis.

Baglivi stresses the significance of substernal pain in the diagnosis of syphilis of long-standing, though he does not correlate it with any special visceral lesion. " Pain, localized in the mid portion of the chest, persistent and annoying, but without cough, is a sign of the French disease contracted many years previously. It may manifest itself by this symptom alone."

Giovanni Maria Lancisi has much to offer from a clinical and theoretical standpoint in regard to aneurysm in his *De Subitaneis Mortibus Libri Duo* and in his *De Motu Cordis et Aneurysmatibus.* He graces the back of the title page of the former with the most prudent admonition: " Beware, lest by chance you burden down your hearts with gluttony, drunkenness and the worries of this life and you be overtaken by that sudden day."

Among the causes of sudden death he stresses aneurysm. He differentiates two types, true aneurysms, *aneurysmata legitiva,* and

the false or *spuria.* The false originate, not from a weakness of the fibres composing the arterial wall, but from an increased force or impetus, direct or reflex, which impels the blood through the vessels. Such aneurysms occur in laborers, trumpeters, etc. The true result from some basic weakness in the texture or resisting power of the vessel wall. Among the latter type belong such aneurysms as are caused by the presence of some erosive matter in the blood stream, lymph or nervous juices. As long as such matter is kept in motion in these fluids, it does no injury. But where it finds some quiet nook and comes in contact with the solid parts of the body, an erosion is produced. In this fashion originate *aneurysmata gallica,* syphilitic aneurysms.

Just as the acrid matter distilling from a gumma or aneurysm can invade bones and ligaments and erode them, so conversely the lymph, teeming in syphilitic salts, may produce primarily a congestion in the bones and ligaments, penetrating secondarily the outer parts of the artery. As the wall of the artery undergoes erosion, the vessel distends to form an aneurysm. And he bases his diagnosis of a syphilitic etiology upon this peculiar pathogenesis of syphilitic aneurysm, upon the fact that symptoms of involvement of some bone or ligament precede the actual development of an aneurysm. Their specific etiology is recognized not only from a past history of syphilis or other coexisting symptoms, but more especially from the manner in which a given region becomes involved. The arterial pulsation is not sensed at the outset, but first there is pain, especially nocturnal, which runs through some ligament or bone. Finally a tumor (gumma) develops, which impinges upon and erodes the artery. In the end, a pulsating tumor results. And he drives home his contention by citing two typical case histories:

"A fishmonger of 45, given to carnal pleasures, frequently indulging in Bacchus, Diana (the chase), Neptune (the bath) and Venus, at length developed from the last, many stigmata of syphilis, which were left practically untreated. Fool that he was, he scoffed at the disease, trusting to his own physical strength. Finally, he became affected with various mental disturbances, his left clavicle commenced to pain, then to raise itself, finally a pulsation developed beneath it, the pain radiating to the arm and neck. In the course of

a month, the surgeon Joan Castigliani was summoned. Upon carefully examining the part, he suspected an aneurysm of the subclavian artery. Coming into the care of a physician ignorant of syphilis, he was purged and bled, and not without great injury to himself. At length, pale, dyspneic, failing in mind, he sought my aid." Minutely examining the involved area and inquiring into the manner in which the disease had originated, Lancisi pronounced the aneurysm to be syphilitic. The acid virus of the disease, lodging in the bones, cartilages and nerve plexus which bind this vessel, eventually oozed through and eroded the vessel wall.

The second aneurysm occurred in a famous harpist, wounded on several occasions during encounters with Venus. At length he developed an arthralgia, for which he took sarsaparilla and mercury, but not methodically. Gradually becoming emaciated, he became afflicted with a pain in the region of the right clavicle, which steadily grew in intensity. Eventually a pulsation appeared. Though the pain abated and the tumor subsided under Lancisi's marvellous *distillatum magistrale antigallicum*, a gem of polypharmacy with its river crabs, tortoises, goat's milk, etc., the pulsation persisted. After six years, the harpist was still alive.

Lancisi, antimercurialist, ingeniously explains why mercurial inunctions tend to cause aneurysm. In good iatromechanical fashion, he has the mercury cause the attenuated blood to rage furiously, and thus this fluid, becoming erosive because of the admixture of venereal salts, strikes against the vessel wall, and like the action of a wedge, rends it asunder.

Whereas Lancisi's clinical descriptions are excellent, for his pathological explanations he allows his brain to run riot. Morgagni, on the other hand, pries carefully into the clinical history, takes scalpel in hand and attempts to correlate the history with the findings he uncovers.

First an account (Epist. LIII, sect. 7) from his teacher, Valsalva:

"A man of about forty, long suffering from syphilis and afflicted with the most cruel pains about his joints and shortness of breath, especially when climbing, fell to earth from a lofty place to which he had mounted by a ladder of forty rungs. At first he cried for

help, soon he lost his power of speech and speedily passed away. Nothing abnormal was found in his abdomen or head. But upon opening the thorax, the entire cavity of the pericardium was found full of clotted blood, which seemed to have erupted from the aorta close to the heart. A probe, introduced from without, was found to penetrate its cavity."

Under diseases of the thorax, in his letter dealing with sudden death from heart disease (Epist. XXVII), Morgagni presents an observation communicated to him toward the end of 1728 by Janus Plancus:[28]

"A nobleman, approaching the age of 59, swarthy of complexion but of good constitution, from his very youth had indulged in venery, as a result of which he suffered on several occasions from buboes. Though his food was coarse and plain, he drank copiously of wine and its spirits. He was a great one with the dice. His fellow gamblers related that daily as evening approached, he was accustomed to be attacked with fits of sneezing which lasted for a quarter of an hour. This condition persisted for some two or three years, at the end of which time he began to lose strength and to suffer from a feeling within, as he described it on several occasions during recent months, as if he were on the verge of dying. For relief, he used no other remedy than the spirits previously mentioned. Having returned home one evening and having repeatedly imbibed of the spirits, all the while his servants being under the impression that he had left home, he suddenly passed away, unbeknown to anyone. Five hours later, as it was winter, his corpse was found frozen.

"Opening his skull, and removing the meninges without difficulty, even the pia came away entire, nothing abnormal was found within except for a considerable amount of greenish serum within the ventricles. But in the pia, all the arterial trunks and their branches, especially those extending to the choroid plexus, were much thicker and harder than normal, and when dried, appeared in many places to be of a bony consistency. The same condition existed in the dura where the arteries were found to be somewhat more thickened (cras-

[28] Giovanni Battista Bianchi, 1681-1761, professor at Bologna. Nothing on syphilis is found in his *Historia Hepatis in Anatome et Morbis Delucidatur* (1711). He was in frequent controversy with Morgagni.

siusculae) than normal. Within the thorax, the lungs were found flaccid and for the most part blackish. Moreover, the left lung was firmly bound down everywhere to that part of the pleura which covers the ribs and diaphragm, except where an abundance of clotted blood was noted. There was even a greater amount in the pericardium, into which it had erupted, as will presently be described, from the aorta. The heart was larger than normal because of the excessive size and capacity of the left ventricle, which had a two-thirds greater capacity than the right. The latter, besides having thin walls, had such intricate sinews within, that there hardly seemed to be any cavity. The aorta and pulmonary artery were larger than normal. Otherwise, the latter showed no changes. The former had ruptured at a distance of about a fingerbreadth from the heart. To be sure, the rupture was not extensive. But, around it and about the entire root of the aorta, there was what resembled an old bruise (*suggilatio*) of blackish blood, lying under the outer tunic. This discoloration extended throughout the lung, especially about the larger branches of the pulmonary artery. Moreover, the inner surface of the aorta was found to be full of prominences and pustules, both of which were found in all its branches as far as they were opened, especially the subclavians, carotids and coronaries. One of the latter vessels was so dilated that it almost equalled the left carotid in size. . . . This man was known to have had *lues venerea* on several occasions."

Morgagni cites that Plancus, in another corpse, had found the aorta ulcerated and eroded and defaced by numerous scattered pustules. This condition Plancus claims to have discovered in the bodies of those who have been infected with syphilis and who are disposed to aneurysm of the aorta and dropsy of the thorax.

Finally there are several observations which belong to Morgagni:

In discussing respiratory disorders due to aneurysms of the heart and aorta (Epist. XVIII, sect. 25):

"In a man of Bellona of about 40 years, who sheared his fleeces with great shears, yet not of the largest nor of the heaviest, the right upper part of the chest began to bulge in the course of the past year. As to the cause, it might have been due to the strong wine of which

he drank too freely, to syphilis, or to both, also to the trade he plied. What complaints had preceded or followed were not known, except that when he returned to Venice about the beginning of October, 1707, he was much troubled with shortness of breath both while walking and during sleep, which was not paroxysmal, nor did it threaten him with suffocation nor prevent sleep.

" That the condition might be ascribed to the man's trade, is suggested by the experience of Kerckring [29] in the workshops of men plying this trade. He was no longer able to eat or drink very much. His face was swollen and of a dusky red, his voice faint and hoarse. For the past twenty days, the tumor could be seen to pulsate even at a distance. During the beginning of the following December, he mingled and chatted, as was his custom early each evening, with his servants. At length, he took to bed and, in the course of time, expressed a desire to sleep. A short time later, he was found moribund, foaming from both mouth and nose. In this state, he passed away at the end of four hours.

" The face of the corpse was swollen and livid, the hands and feet were not swollen. The prepuce and glans were swollen and gave off an offensive odor as though they were on the verge of becoming gangrenous. Though Santorinus [30] and I were very desirous of examining the urethra, we were unable to do so, owing to the time, the place and those who perchance were present. Opening the abdomen, we noted the liver and spleen to be harder than usual, the latter viscus being unusually large. We then turned our attention to the thorax. Externally, in that part of the chest, which lies between the right axilla and the sternum, a tumor protruded in the shape of a hemisphere, somewhat flattened, stretching from the fourth rib to the clavicle, nearer the sternum than the axilla. It yielded to pressure. There were no bones or cartilage covering it, such as are normally found between the muscles and the thoracic cavity. We found the clavicle fractured and eroded by caries, and that portion of the upper four ribs which long remains cartilaginous, necrotic and eroded by the aneurysm. This was larger than a kid's head and oval

[29] Theodor Kerckring (1640-1693), pupil of de la Boë.

[30] Giovanni Domenico Santorini of Venice (1681-1737). His anatomic plates published posthumously by Girardi were considered as masterpieces by Morgagni.

in shape, extending from the base of the heart to the uppermost part of the thorax. It was a saccular aneurysm, the left side of which communicated with the right side of the aorta, in that portion of the vessel before the innominate is given off, through a foramen which admitted two fingers. This aneurysm seemed to originate from the substance of the aorta, but was whiter, tougher, more compact, but not very thick. Numerous curved laminae lined its walls, one over the other, fibrous and polypoid, but desiccated and containing so much dried blood that, when this was removed from in between the laminae and placed upon a scale, it weighed forty ounces. The aneurysm had pushed the right lung backward and to one side, more because of its mass than because of pressure. When cut, the lung gave forth a whitish pus, which flowed here and there from the dissected bronchi. The left lung was sound. In both thoracic cavities, but more so on the right, there was an abundance of yellowish serum in which were mixed bodies like threads of mucus. By virtue of this yellowish mucus, the pericardium was everywhere adherent to the heart. In the right auricle and adjoining ventricle, was a polyp-like clot. The pulmonary artery contained blood, the left ventricle neither blood nor clot. Finally the descending aorta was in spots irregular on its inner surface, with signs of ossification in the areas of sinewy hardness."

Again, there is a remarkable instance of unsuspected abdominal aneurysm (Epist. XL, sect. 29).

"An old man, said at one time to have been infected with *lues venerea,* lay for many a day in this hospital, complaining of every other symptom save any that might point to this disease or to a huge hidden aneurysm. Though I questioned him most carefully, he complained of no pain, no feeling of pressure, no difficulty in breathing. About the middle of December, 1718, he suddenly died after partaking of dinner. Opening his abdomen, I removed the bladder along with the penis, for I was at that time busy carrying out investigations on these parts. The urethra gave ample evidence of the correctness of my suspicions of an old *lues venerea.* It was everywhere scarred, and the seminal caruncle (verumontanum) was of abnormal conformation, so that it was difficult to demonstrate the

two minute orifices (of the ejaculatory ducts), which perforate it on each side, or the orifice of the sinus (utriculus prostaticus) between these two. Removing the viscera, there came into view a huge aneurysm of the aorta, shaped like a crescent, whose convex side lay transversely under the diaphragm to which it was attached, and whose horns pointed downward, each one hiding its corresponding psoas, the left extending down to the lower third of the muscle, the right did not extend quite so far. The aneurysm was without a posterior wall. Removing the blood which filled it, consisting in great part of polyp-like laminae one over the other, there came into view the bodies of two or three vertebrae of the lower thoracic and lumbar region, without covering and deeply eroded, with the cartilages interposed between the vertebral bodies still white and sound. However, the aneurysm had ruptured on its inner left aspect in such a fashion that the blood, where the diaphragm permitted, had on the same side burst into the thoracic cavity, which it almost filled. You see, then, how obscure may be the symptoms caused by such an aneurysm."

Again in a forty year old syphilitic butcher (Epist. LVIII, sect. 13 and 14):

"In one of the aortic cusps, the nodulus valvulae semilunaris (corpusculum Arantii) was much larger than normal. Under it, on the surface of this cusp which faces the other cusps, the membranous laminae of which it was constructed were so rent asunder that when they gaped, a probe could be passed between the two. That part of the aorta, nearest to the heart, was everywhere marked with whitish spots, somwhat rough, at times elevated. As the arch was approached, the aorta became distended into an aneurysm."

There are other observations in Morgagni's work which pertain to syphilitic aneurysm. As there was no past history of syphilis nor any associated signs of the disease, such an etiology is left unmentioned. To cite two such observations:

(Observation of Valsalva, Epist. XXVI, sect. 5). In the letter dealing with sudden death from disease of the blood-vessels, especially of those of the thorax: "A youth of about 27 years presented over a long period on the right side of his chest between the

third and fourth ribs a pulsating tumor whose contents could be felt to fluctuate when he turned from one side to the other. While at prayer he suddenly passed away. There was found a great aneurysm, commencing where 'the carotids were given off,' extending to the sternum, to which it was so firmly attached that it could not be separated without being torn. It extended under the right clavicle to the third and fourth ribs, the inner surface of which it had eroded. Rupturing into the pericardium, it had filled this cavity with blood."

Another syphilitic aneurysm observed by Morgagni (Epist. XXVI, sect. 13):

A 28 year old prostitute died suddenly in the act of plying her trade. "The diseased condition commenced at the extreme left of the aortic arch and extended to the heart. As the aorta approached the heart, it progressively became more distended. In places were observed whitish patches which gave promise to ossify, in other places there were small foramina as if in the very process of forming, elsewhere there were parallel sulci which stretched longitudinally. Thus its surface was everywhere irregular. As one approached the semilunar valves, which seemed thinned out (*strigosae*), about a fingerbreadth above the posterior cusp, was seen an orifice large enough to admit the tip of the thumb. Through this the aorta communicated with a roundish aneurysm, suspended to the vessel like a sack. This aneurysm was larger than a walnut with its green shell and was so situated on the posterior wall of the aorta that when it was turned to the left, it did not seem to interfere with the function of the left auricle or the adjoining sinus."

V. The Brain

Next to the liver, it was the brain which was incriminated as the viscus most at fault in syphilis. According to traditional humoral doctrines, the phlegm, pituita, or rheuma, was excreted daily in small quantities through the cribiform plate. In disease involving the phlegm, this humor accumulated within the cranium, whence it supposedly escaped through one of two channels: through the minute pores of the ethmoid bone, or via the nerves to the bones, joints and tendons. Thus originated in syphilis, headache, osteocopic pains,

periostitis, tophi, etc., and as a result of the erosive action of an acrid phlegm, lesions of the buccal cavity. A classical description of such a Galenic pathology has already been quoted from Fernel's *De Abditis Rerum Causis* [*Janus*, 1934]. Similarly, mercurial salivation and stomatitis were interpreted as due to the expulsion of acrid phlegm through the cribiform plate. But within a short period of a score and three years, four discoveries sounded the death knell of this hoary but erroneous conception. In 1660, Conrad Victor Schneider demonstrated that while in the skeleton the cribiform plate was seen to be perforated by numerous fine pores, in corpses, on the other hand not yet despoiled of flesh and membranes, the entire bony surface of this structure was covered by an impervious dura. Thus the conception of catarrhal disease and its treatment by *caput-purgia* was completely shattered. Then in rapid succession were described the various salivary ducts with their orifices into the buccal cavity (ductus sub-maxillaris, Wharton, 1656; ductus parotideus, Stenson, 1661; ducti sublinguales minores, Rivinus, 1679).

Between the previously cited autopsy of Botallus (*Janus*, 1934) on a syphilitic with cranial necrosis and terminal meningitis and the descriptions of cerebral syphilis by Morgagni, several other autopsies on syphilitic brain disease are recorded. They vary extremely in value. As an example of an utterly worthless account, I can do no better than cite an observation of Georgius Garnerus included among the *Observationes* of Schenck (Lib. IV, obs. 13). Let us say in behalf of this fellow Garnerus, with the surname George, whom Proksch [81] would identify with Pierre Garnier, physician to the Hôtel-Dieu in Lyons from 1695 to 1719, that he is really pre-Schneiderian by a good century. The cerebral humors had as yet not ceased to seep through the cribiform plate. His morbid tale is entitled: "Concerning a certain syphilitic, notorious for his lewdness, whose brain was presumably drawn downward by tenches."

"In the Hospital of St. Peter and St. Paul, Andreas Lippeneus, of noble blood, a most degraded fellow, after a long standing dose of the French disease, with its horde of symptoms, finally devel-

[81] An obvious error by Proksch (*Geschichte der vener. Krank.*, II, 367). This account is already included in Schenck.

oped, as befits an old worshipper at the shrine of Venus, a most cruel cephalalgia, which failed to respond to the efforts of the most competent hands. All kinds of medicines were administered, but without avail. Four times he was subjected to a 'diet,' twice to fumigations, five times to inunctions. In spite of all this, day and night, but especially at night, he suffered so excruciatingly that he frequently attempted to commit suicide. Finally a certain bold Flemish quack, hautier than an old pirateer, promising heaven and earth to the poor wretch almost dead of pain and in utter desperation, tied, unbeknown to us, fish, commonly called tenches,[32] to the soles of his feet and kept them there for a whole day and night. At length, his vital and animal spirits being dispersed by such suffering, he received the rewards of his foul lust, and, by God's mercy, exchanged this miserable life for a better one. Upon his demise, the opportunity to dissect him was offered me, inasmuch as he and his family had been entrusted to my charge. So, placing the corpse in a suitable position, making fast his head and shaving off the hair, I incised the skin from the vertex to the forehead down to the region mid between the eyebrows and so to the root of the nose, then from the vertex almost to the neck, and, in the manner of a cross, to the temples and to the roots of the ears, this because of the numerous syphilitic ulcers with which his skull was sown. Having made these incisions, the skin was raised together with the fleshy membrane, and with a saw, I made a circular opening into the cranium. Freeing its membranes, the pia and dura mater, I found nothing of the brain within the whole cranium, except some mucus and phlegm, much digested, which filled scarcely the fourth part of the cranium. Meanwhile, such a stench came from the feet, to which the tenches had been tied (it was midsummer and ragingly hot), that none of my assistants, indeed, not even I, could endure it, even for the space of a quarter of an hour. So, opening the belly in a jiffy, viewing with all haste the intestines and abdominal viscera, I turned the body over to the sexton for burial." And now the learned doctors go into

[32] Dodoens in his *Med. Obs.* remarks: There are some who tie tenches to the feet in the forementioned diseases (fevers) and not without benefit, but with less comfort to the patient, and with a more offensive stench than from the application of a (slit) dove. Paulus Ionius (?) mentions this use of tenches in his book on Roman fishes.

a huddle to discuss these strange findings. " There was much controversy whether the brain had been consumed by syphilis and venery, or whether it had been drawn through the spinal cord and nerves by the fish tied to the soles of the feet. The most distinguished master, Nicolaus S. Michäel, alias Comascus, thought it more probable that the brain had been consumed by disease and venery than that it had been drawn downward by the fish, because of the countless obstacles which would be met in the bones through which it would have to pass. On the other hand, others, and most vehemently the distinguished physician John Siccus, insisted that there was present in these fish a great force of attraction, nor was that to be marvelled at, inasmuch as daily experience teaches us that there exists in some bodies, a great force beyond our understanding." And Garnerus, himself in a quandary, ends with the comment: " Let each one believe according to his own experience."

What might be called a good fish story! But of value to contrast with the more serious observations which follow.

One more observation of this type. It is also in Schenck, and is taken from a *Scholia* of Petrus Forestus.[88] It is entitled: " Upon opening the cranium of a syphilitic, a weevil was found under the dura, and upon its removal, the patient was relieved of chronic headache."

" I know of a certain individual, at one time infected with syphilis, who, in spite of thorough treatment, was afflicted with persistent headache, for which no remedy brought him the least relief. At length, at Bologna, where I was at the time occupied, his brain was exposed by a very skilled surgeon. In the upper part of his forehead, where the pain was localized, there was found under the dura, something blackish like a weevil. . . . When the worm was removed, the pain ceased as if by a miracle and never recurred."

An autopsy related in the *Consultationes* of Christopher Guarinonius (added by Manget to his 1700 edition of Bonet's *Sepulchretum*), as far as I know, is the first instance of precocious neurosyphilis to come to post-mortem study. It is under the caption: " In a man infected with syphilis, with headache, epilepsy, melan-

[88] Peter Foreest (1522-1597) of Alkmaar, Holland.

choly, cachexia, unilateral ophthalmia, the left sinus of the brain was found to be full of water, a part of the brain itself being corrupt and having gummata within."

"There was present a complication of symptoms of the disease (morbus Gallicus) along with melancholy and epilepsy. In a man, formerly of the best constitution, there broke out over his head pustules while he was having epileptic attacks. Then followed headache accompanied by discoloration and livor of the entire body (profuse secondary rash?). Especially was this noted in his eyes (circumcorneal injection of iritis?), a familiar phenomenon in syphilis, and accepted by skilled physicians as a sure sign of the disease. On his legs were soft white tumors. He appeared drowsy, though not to the point of coma. His memory was badly impaired. His hearing had also been impaired at the onset of his illness, but, eventually, it regained its former acuity. More recently, there set in another symptom of grave import. There occurred a flux to his head, which incited the most violent epileptic attacks. Moreover, the use of certain nerves was lost, especially those of the tongue. The epilepsy was preceded by most excruciating and stubborn headaches, involving the right side of the head. Upon their first appearance, these symptoms of syphilis had readily been cured by guaiac, so that by the eighth day of the decoction, the left eye had lost its redness, the pustules had disappeared from the sinciput, the ulcer on the glans had healed, and he remained in good health during the remainder of the course of wood, which lasted the usual forty days. Subsequently, on the occasion of a mild tempest, during which he exposed himself to the wind, he was again seized with headache and deafness, reddish macules broke out on his right temple and forehead (our *corona veneris*), there developed also a redness of the entire eye, but without pain, though he could see nothing with this eye (uveitis). Though it was winter, he seemed to convalesce under guaiac and was apparently keeping in good health, when suddenly in the region of the sinciput, the skin swelled with a very soft edema, the joints were racked with pain, the glans eaten away by ulcers, and a thousand other ills followed. Then he was brought to Padua to drink of the waters. Returning to his native soil, he was attacked by persistent convulsions, especially of the neck and one arm (Jacksonian?), nor

could he speak distinctly. His physician imagined this epilepsy was caused by a demon, which he called *mutum*. At times, the afflicted man could not use his tongue at all. Finally he passed into a lethargy and died.

"Upon opening his head, the left sinus of the brain was completely filled with water, part of the brain was corrupted and gangrenous. In the midst of this corruption, were three bodies like growing gummata. His fever had been very high, and, while in a deep sleep, had carried him away."

Johannes Rhodius (Lib. I. obs. 32) tells at third hand of a finding of Molinettus: "In the anatomical theatre at Padua, in the year 1651, Antonio Molinetto opened the skull of a peasant infected with syphilis, and found three gummata which were adherent to the dura. The pia was uninjured, its remains were easily distinguished within the eroded skull. This observation occurs in the treatise of Lud. Mercatus [84] on the French disease."

In the second section of Thomas Willis' *De Anima Brutorum*, which deals with the pathology of the nervous system, there is considerable of interest on syphilis. According to Kraft-Ebing,[85] the first suggestion of a recognition of a symptom complex consisting of a simultaneous development of motor and psychic defects, so characteristic of dementia paralytica, occurs in the section *de paralyse* of this work: "I have on numerous occasions observed in individuals that when their brain becomes diseased, they become affected with a hebetude of mind, forgetfulness and then imbecility, or, as the Greeks say, *morosis*. Eventually, they become paralyzed. In such individuals, I am in the habit of prognosticating such an outcome." Willis does not mention syphilis in this connection.

In this same work (Pars II, Cap. I, *De cephalalgia*), in connection with cerebral syphilis, Willis makes the significant observation: "I have known phlegmons, abscesses, tubercles and scirrhous tumors to develop in the membranes of the brain, uniting the membranes

[84] Luis Mercado (1520-1606), professor at Valladolid. Part III of the second volume of his *Opera Omnia* is entitled: De morbo galico (sic), libri duo: quorum primus ejus naturam et curationem in genere continet: secundus omnium ejus accidentium.

[85] Nothnagel's *Spec. Path. u. Ther.*, IX, 3, p. 3.

with the cranium. There are also other pathological lesions. As a result of these, there develop frequent and excruciating headaches, lasting over long periods. Finally stuporous and lethal symptoms set in. The actual cause of the disease can only be determined by autopsy. And one is justified in suspecting that chronic and persistent headaches, which recur in spite of all remedies, and day by day become more excruciating, depend upon such an incurable cause."

Of interest are the speculations of Vidius Vidius (Guido Guidi, d. 1569), recorded in the *De Curationibus Morborum* of his nephew of the same name, as to the pathologic basis of epilepsy occurring in a syphilitic with necrosis of the skull:

"We saw at Barcelona, a certain French soldier, who developed a foul caries of the calvaria from the French disease. Shortly thereafter, he began to suffer from frequent and severe attacks of epilepsy, which, though he was in his fortieth year, had never before afflicted him. From this symptom he was shortly afterwards entirely freed by means of cautery and other procedures recommended by us. Thus the foul carious matter was removed from the calvaria. It was our opinion that a droplet of this matter had descended from the dura, giving rise to contractions and concussions, the purpose of which was to expel this noxious body. Thus the epileptic fits were incited. The objection cannot be raised that the brain is destitute of feeling and so cannot perceive its own substance nor any corrupt matter it may receive. For though this is true of its substance, the two membranes, however, are exquisitely sensitive, as are the beginnings of the nerves which arise from it. Whenever these structures sense an injury, they contract and concuss, and the brain does likewise. So do the muscles in a chill following the first paroxysms of intermittent fevers. They quiver in order to expel the injurious vapors and humors passing to the sensitive flesh."

Finally we come to the descriptions of cerebral syphilis contained in the *De Sedibus et Causis Morborum* of Morgagni. We have already described the supposed instance of syphilis of the cerebral vessels in an individual who died of a ruptured aorta, an observation of Janus Plancus' 61 year old patient. More of him in the subsequent discussion. An observation of Valsalva (Epist. IX, sect. 23):

" A woman presented two tumors, commonly called gummata, on the upper part of the forehead. She was given mercury and a salivation raised. The one to the left fell away, the one to the right persisted. It was learned that before she had taken mercury, she had been subject to epilepsy, and on one occasion, had had an attack during the very midst of treatment. Upon its completion, she was again seized with convulsions, during which she frothed at the mouth. Finally, without any bodily ailment, she lapsed for some days into a sort of stupor, during which she seldom spoke. About the middle of October, 1739, she passed away.

" Upon examining her skull and brain very carefully, it was found that the prominence was covered by a membrane of the thickness of what we call ' cartone,' cardboard, but so flaccid that, rubbed between the fingers, it was easily torn to shreads. This membrane replaced both meninges, and the cortical substance of the brain lay immediately beneath it and was firmer than normal down to the very medullary substance, indeed as firm as is the liver. But the rest of the left hemisphere, the posterior portion excepted, was, in contrast, much softer than normal. In it was a cavity the size of a walnut, with its pale soft walls made up of medullary tissue. Upon opening it from the top, there flowed forth, without offensive odor, first a fluid of blackish color, then one like whey, in which floated thread-like bodies. The cavity impinged upon the anterior part of the lateral ventricle. It communicated neither with the ventricle, nor with the prominence previously described. In fact, they were two fingerbreadths apart. A foramen in the cranium, elliptical in form, corresponded to the prominence on the skull. On every side the rim was smooth as though it had been polished with a file. Such were the findings on the left half. On the right half, nothing remarkable was discovered. As for the cranium, the tumor which had not been resorbed, had not as yet eaten its way to the inner surface of the skull. In another area, however, in which the bone had been entirely destroyed, there was a sort of underlying membrane. Possibly at some other time, another tumor had been resorbed as the result of mercurial inunctions."

A second observation belongs to Morgagni. It occurs in his letter (Epist. I): " *Spectat ad dolorem capitis.*"

" I well recall, because of her color, another woman, whose head I dissected at the very beginning of the year 1717. First infected with *lues venerea,* she subsequently was seized with fever and excruciating headaches and then delirium. As a result, she passed away in the hospital at Padua.

" Her skull, upon being cut open, appeared everywhere of a blackish red. The part of the dura mater, which lies nearest the upper median portion of the lateral sinus, was much thicker than normal and had become attached to the pia and the brain substance itself. In this region all three of these structures were necrotic and livid in color, of a yellowish gray, especially the cortical portion of the brain. In fact, the outermost substance of the underlying cerebellum, though to a lesser extent, was so firmly attached to the meninges for a space of two fingerbreadths that when the cerebellum was removed from the dural cavity, its substance was left attached to this membrane. The vessels of the brain were seen to issue abruptly through the pia, were more distended than normal and were filled with a blackish blood as were also the sinuses in the dura. When the medullary substance of the brain was carefully dissected, there was seen everywhere, numerous, unusually distinct blood vessels. The lateral ventricles were full of a yellowish fluid, which color likewise tinged their surfaces. The pineal gland was firmer, larger and whiter than normal and contained what seemed to be small pockets. We ought not to pass in silence the fact, since it falls into the same category with a rare observation reported in the *Commentaries* of the Royal Society of St. Petersburg, that from birth, or at least from earliest infancy, this woman's skull was peculiar in that the right side bulged posteriorly more than did the left. Accordingly, the cranial cavity and the enclosed cerebral hemisphere were obviously larger on the right side than on the left. . . .

" I do not know whether this woman had been subject to headaches, as her whole history before the onset of fever was unknown to me. But I do know that a defect in the shape of the head is considered of great moment in the production of chronic headaches. . . .

" Had this woman, and the above mentioned girl, been addicted to the use of tobacco, then one might attribute the yellowish or blackish discoloration noted on the inner surface of the cranium of both to the soot of its smoke. . . .

" Though this woman had suffered from *lues venerea*, never was she affected with caries of the cranium, which condition might have been suspected because of the atrocious headaches, though the outside of her skull, neither by any swelling or discoloration, gave any indication of such a lesion, as is reported in other observations, especially one related to me by Novesius in 1704 in Bologna as occurring in a certain handsome prostitute and which he later reported in his letters."

Discussion

The progress of pathologic anatomy in connection with syphilis may be visualized as consisting of three peaks and two valleys. Whether one accept the antiquity of syphilis in the *Old World* or the American origin of the disease, there is only barren land before 1497 as far as our subject is concerned. The pathology of syphilis begins abruptly in the last few years of the fifteenth century.

Among other contributions to medicine, the Renaissance brought an intense interest in the study of the normal anatomy of the human body. What more natural than that the corpses of those dying of this alarming and repulsive disease should be anatomized to unravel its ' hidden causes ' (*abditae causae*). As evidence of the dual interest on the part of the dissectors of this turbulent period are the eponyms firmly anchored to anatomic structures, names of men who lent their hands not only to investigating the normal structure of the body, but also to dissecting syphilitic corpses (Falloppius, Botallus, Vesalius). In normal anatomy the background required was far less exacting. A scalpel, a level head, a keen eye ready to see, not what Galen said should be found, but what the knife actually revealed. But in pathologic anatomy, the barriers were too great to be surmounted. The normal structure of the human body was in the very process of being studied. How, then, could pathologic changes be evaluated? Moreover, the humoral doctrines of Galen were too securely saddled to be so easily shaken off. Harvey's discovery of the circulation was a good century off. The conception of fluxes, of the ebb and flow of humors, controlled in health by provident *nature*, was still the basis of explanations of disease phenomena.

There is, however, one contribution to pathology which over-

shadows all others. It is to the credit of Ambroise Paré, whose humble shoulders already are heavy with the appreciation of posterity. His section on syphilis is taken almost *in toto* from the *La Méthode Curatoire de la Maladie Vénérienne Vulgairement Appellée Grosse Vairolle* (1552) of Thierry de Heri. Paré gives full credit to his one-time fellow apprentice at the Hôtel-Dieu in Paris. Thierry de Heri's work rests peacefully on the library shelf, to be disturbed only at rare intervals by the delver into the history of syphilis. But this one observation of Paré, the autopsy on Belanger, the master tailor, who lived on the Pont Saint Michel, near the Sign of the Cock, is a landmark in the pathology of syphilis, the first mention of the causal relationship between syphilis and saccular aneurysm. True, it was only too soon to be forgotten.

Though there continued to appear sporadic accounts of autopsies on syphilitics, the last part of the sixteenth and the greater part of the seventeenth centuries were again in the main unproductive. Not that many autopsies were not performed (note the quotation from Severinus previously cited), but important contributions were scarce. It was in Italy, as before, that great dissectors were again to attack the pathology of syphilis. The second peak begins with the keen clinical observations of Lancisi, who gave new impetus to subsequent anatomical studies. The peak is reached in the autopsies recorded by Morgagni. But the capable and revered teacher, Valsalva, must not be forgotten.

Aortic syphilis again takes its " place in the sun " in the pathology of syphilis. Piecemeal is assembled a comprehensive symptomatology for this tardy manifestation of *lues venerea*. The peripheral pulsation of the arteries was noted (later to be correlated with aortic regurgitation with its Corrigan pulse), the paroxysmal dyspnea and orthopnea, the substernal pain, the terrifying anginal attacks. The relationship between sudden death and aortic aneurysm are stressed. Then there is Morgagni's tremendous aneurysm of the abdominal aorta latent as far as clinical symptoms are concerned.

Naturally there was much confusion between arteriosclerosis of the aorta and syphilitic aortitis. Bianchi's observation, previously quoted, with calcification of the aorta as well as of all its branches as far as they were opened, with ulceration of the aortic wall, was

likely arteriosclerotic or a combination of syphilis and arteriosclerosis. The associated sclerosis of the cerebral arteries, the age of the patient (59), supports such an etiology. It should be stressed, however, that rupture of the aorta is a far more frequent disaster in syphilis than in arteriosclerosis. Morgagni's description of the aortic wall in syphilitic aortitis is a classic. It occurs in the observation pertaining to a twenty-eight year old prostitute already given in translation. "Vitium autem interius a sinistro arcus Aortae extremo incipiebat, et inde ad cor usque pertinens, eo fiebat majus, quo arteria proprius ad cor accedebat. Scilicet alibi *indicia* occurrebant *subalba futuri ossis*, alibi quaedam *inchoata quasi foraminula*, *sulci* alibi *paralleli in longitudinem ducti:* sic passim arteriae illa facies erat inaequalis." Compare Morgagni's words with those of a recent description (MacCallum's Textbook of Pathology): "There is a great roughening of the lining, which is thrown up into irregular folds and nodular swellings, some translucent and pearly, others yellowish and opaque, where there is fat accumulation. But nowhere is there any formation of calcified plates and ulceration. Beginning usually at the aortic orifice, and generally involving the aortic valves, this change is most commonly found in the arch and extending downward into the descending aorta, where it usually stops abruptly at a point somewhere above the orifices of the abdominal vessels. . . . A further characteristic of the intima is its peculiar wrinkling. It is thrown into longitudinal rugae, quite unlike anything seen in arteriosclerosis. Thinned out and scarred areas are frequently seen in the walls, and dilatations of all sorts, from small saccules to aneurysm of the hugest size, may accompany the latter stages of the disease."

As to brain syphilis, there was considerable insight into the multiplicity of reactions on the part of this viscus and its coverings. Intracranial and meningeal gummata as well as gummatous osteomyelitis of the cranium with extension to the adjacent meninges and cortex were noted. Bianchi's thickened cerebral arteries may possibly have been instances of Heubner's endarteritis.[86] From a clinical standpoint, there was full appreciation of the rôle played by syphilis

[86] Proksch (*Geschichte der vener. Krank.*, II, 417) wrongly ascribes this observation to Morgagni.

in the production of chronic headache, epilepsy, paralysis and other cerebral disorders.

With no other criterion at their command except the relative frequency of certain pathological findings in corpses of individuals who gave a history of having had syphilis during life or who presented external evidence of past infection (nasal deformity, palatal perforation, cutaneous scars, tophi, etc.), these investigators were at times led into error. Note the observations of Morgagni of frank pulmonary tuberculosis which were interpreted as a venereal phthisis. But considering the tools at their disposal, many of them labored like real masters.

The contributions of these Italian dissectors were again to be neglected but this time for a much shorter period. Exactly twenty-five years after the appearance of the first edition of Morgagni's *De Sedibus et Causis Morborum*, John Hunter in his *Treatise on the Venerael Diseases* (1786) glibly passes off the question of visceral syphilis with the remark: "But it would appear that some parts of the body are much less susceptible of *lues venerea* than others; and not only so, but many parts, as far as we know, are not susceptible at all. For we have not as yet had every part of the body affected; we have not seen the brain affected, the heart, stomach, liver, kidneys, nor other viscera; although such cases are described in authors." The late eighteenth century again finds the pathology of syphilis in a slough. This time the investigations were to assume a more international character. First the French and British were to take renewed interest in the pathology of syphilis to be followed by the great advances of German investigators based on Virchow's new conceptions as to disease and its reaction on the human tissues. But this lies beyond the scope of the present study.

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IN MEMORIAM

DR. JOHN RUHRÄH (1872-1935)

After a painful illness, Dr. John Ruhräh, one of the leading pediatrists of his period and a contributor to the history of his subject, died in Mercy Hospital, Baltimore, at 3 a. m. on Sunday morning, March 10, 1935, at the age of 62.

Born of German parentage at Chillicothe, Ohio, on September 26, 1872, Dr. Ruhräh acquired his early education in the public schools of this historic town, once the capital of the Northwest Territory (1800-03) and of his native state (1803-16). Graduating from the Chillicothe High School in 1891, he moved to Baltimore, the home of his maternal grandmother, to study medicine, receiving his M. D. from the College of Physicians and Surgeons (University of Maryland) in 1894. While following post-graduate courses in the Johns Hopkins Hospital, he was successively Assistant Resident Physician (1894-5) and Resident Physician (1895-7) to Mercy Hospital and demonstrator of bacteriology to his *alma mater*. In 1897, Dr. Ruhräh went abroad to study at the Pasteur Institute (Paris) and upon his return, took charge of the Pasteur Department of the College of Physicians and Surgeons and became quarantine physician to the port of Baltimore (1898-1900). About the same time he was appointed Associate Professor of the diseases of children in the Maryland Faculty (1898-99). After a year of post-graduate work in Vienna, Berlin, Paris and London, he began the private practice of his profession (1901) and a year later, became Clinical Professor of the diseases of children, therapeutics and internal medicine in the Faculty (1902-6). In 1906, he became full professor of his specialty and in 1915, Professor of Pediatrics in the University of Maryland, which chair he held for the rest of his life (1915-35). A club man of sorts and prime mover in many medical societies, Ruhräh was physician to several local hospitals and successively president of the Medico-Chirurgical of Maryland (1919), the American Pediatric Society (1925), the Medical Library Association (1927), the Research Society (1932), the Osler Historical Society (1933-35) and the American Academy of Pediatrics (1934).

In February 1932, he became a member of the School Board of Baltimore.

Dr. Ruhräh was author of *A Manual of the Diseases of Infants and Children* (1905), which passed through four editions, and of a number of special contributions to his subject in Osler's *Modern Medicine* (1907) and elsewhere. With Julius Friedenwald, he collaborated in two books on *Diet in Health and Disease* (1905; 6. ed., 1925) and *Dietetics for Nurses* (1905; 5. ed., 1924), and with Erwin E. Meyer in a monograph on poliomyelitis (1917), which became authoritative. Under the spell of Osler and Welch, he acquired an interest in the history of his profession, beginning with his study of Robert Whytt (1904) and culminating in his anthology of basic pediatric texts (*Pediatrics of the Past*, 1925). This contains full-length translations of the pediatric incunabula of Bagellardo, Metlinger and Roelans, as well as reprints of *Phaer's Boke of Children* (1545), the *Children's Book* of Felix Würtz (1656) and the *Epitome* of the younger Heberden (1805). It was acclaimed by Sudhoff as a source-book of permanent value, like Smith's *Rara Arithmetica*. Upon this solid foundation, Ruhräh began to study the remaining pediatric texts in the Meissner bibliography of 1850, as a preliminary scaffolding to a large-scale history of the subject. The cultural background was not neglected and was often the theme of charming lantern demonstrations. An edition of Cadogan on gout (1771) appeared in 1925, a series of *Pediatric Biographies*, reprinted from the *American Journal of Diseases of Children*, in 1932, and a translation of Fujikawa's history of Japanese Medicine (Clio Medica Series) in 1934. A life of Osler is in the press.

A man of broad cultural interests and cosmopolitan tastes, Ruhräh travelled extensively during vacation, knew all the superlative cafés of Europe, and could speak French, German, Spanish and Russian like a native. He was a confirmed first-nighter at the theatres and seldom missed a local concert. At the charming musicales at the home of Mrs. John W. Garrett, he was a familiar and beloved figure. While sojourning with musical friends in the island of Capri, he was incontinently stricken with poliomyelitis in October, 1930, was transported in a helpless condition to Baltimore and invalided in

Mercy Hospital, the scene of his first endeavors to get sick people well. Here began a tedious, painful, uphill fight for the recovery of muscle after muscle, sustained with a serene, stoical fortitude, which was a lesson in *morale* to all his friends. Partial recovery was effected at Warm Springs, Georgia, whereupon Ruhräh quietly resumed his office hours, as if nothing had happened. In spite of impeded locomotion, hard to bear in a man of his handsome presence and physique, he became as active in medical, musical and social gatherings as the demands of his large practice would permit, while a definite compensation for semi-invalidism was found in extensive literary labors. Before his death, he had travelled all over the country, addressed many medical meetings and shaped three books for the press.

In person, Ruhräh was tall, dark, of handsome, even distinguished appearance, an upstanding man, with a strong sense of personal dignity, who accepted the world's plaudits and buffets with equal thanks, and feared not his audit. Albeit brutally cynical on occasion, *au fond* he was not unkindly, and children came to him naturally. He knew how to hold and quiet a baby and was in fact, the ideal infant's doctor. To be equally beloved and esteemed by men, women and children alike is no small achievement in a bachelor. It was said of old that even the fool, by pursuing this simple aim, shall eventually arrive at wisdom. During the abrupt and painful illness which ended his days, Ruhräh displayed the same serene fortitude and indifference to fate which had made his comely outward semblance and manner so attractive to his intimates in his prime.

F. H. Garrison